MECHANICAL ENGINEERING

November 1959

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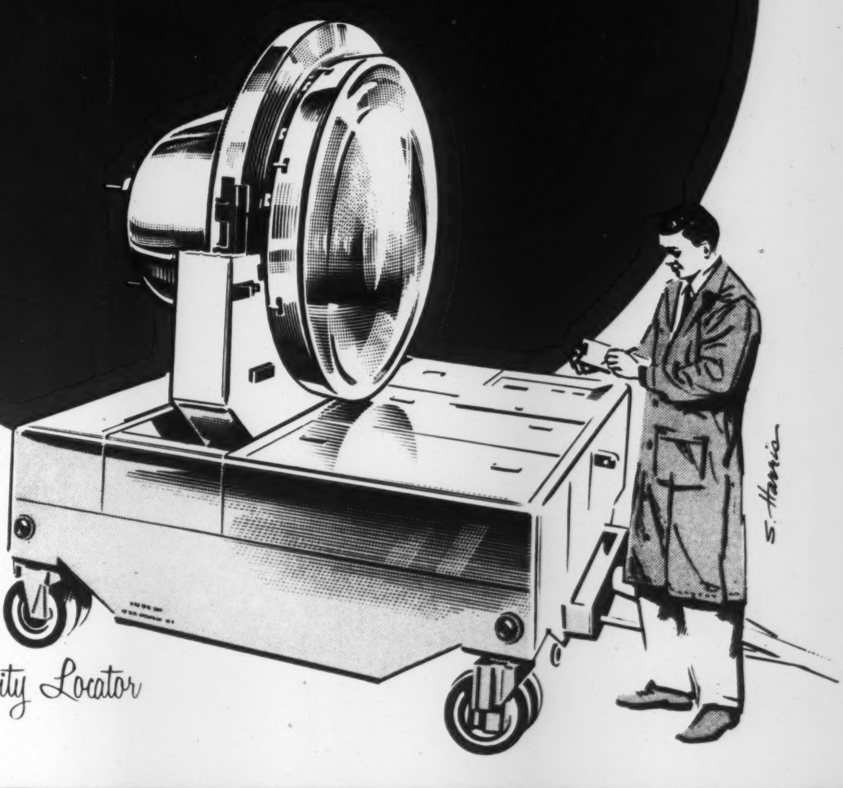
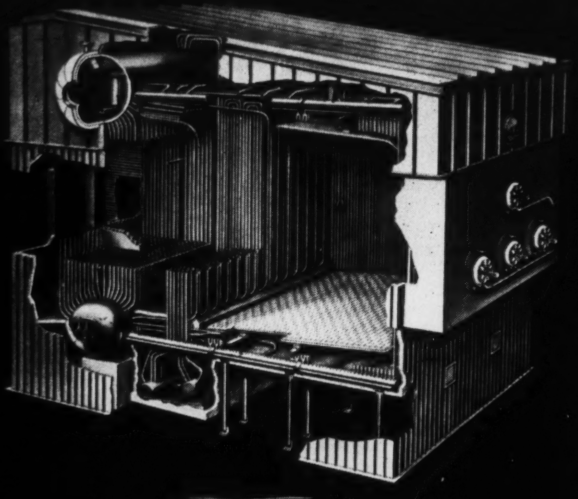
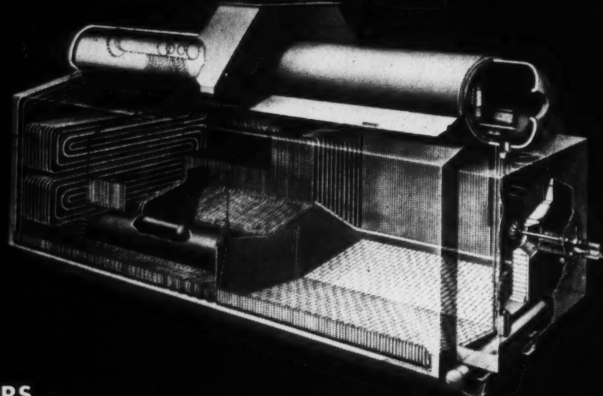


Weight and Center of Gravity Locator



B&W INTEGRAL-FURNACE BOILER, TYPE PFI—The PFI, B&W's new Integral-Furnace Boiler, produces steam in the general range of 80,000 to 400,000 pounds per hour. Oil or gas, or a combination of both, can be used as fuel. In power, process or heating applications, the pressure fired PFI assures clean, dependable steam over a wide load range. The drainable superheater, at left center, permits the draining of water after a shut down, facilitating easy storage and simple, safe start-up. Generous tube spacing prevents ash or slag pluggage of the superheater. The burners at extreme right are centralized for easy observation and adjustment, while the integral combustion air duct at the top of the unit saves space.



B&W INTEGRAL-FURNACE BOILER — TYPE FO — B&W's new package boiler offers economy, convenience and quality at capacities from 60,000 to over 100,000 pounds per hour. A natural circulation boiler, the FO combines the advantages of the package boiler with the proved reliability of B&W Integral-Furnace design. The FO Boiler has a completely water-cooled furnace of ample volume, and is designed to provide steam at pressures from 250 to 775 psi at temperatures up to 750 F.

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BOILER DIVISION

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Nation's largest High Temperature Water installation heats U.S. Air Force Academy

The year 1959 marks a milestone in the history of The United States Air Force—the year in which members of the first graduating class at the U. S. Air Force Academy earned their commissions.

Situated in the Rampart Range of the Rockies north of Colorado Springs, on a 28-square-mile site, the new academy incorporates many notable advances in design and engineering. For example, the heating system which services the widely-spaced buildings utilizes *high temperature water*. This system, compared to steam, frequently offers important advantages for large-scale heating. Since hot water has an inherently higher capacity to contain heat, it not only reduces initial equipment costs, but also makes possible operating and maintenance savings of from 10% to 20%. Smaller-sized pipes can also be used, steam traps and pressure valves are eliminated, and the boiler plant can be smaller—more compact than required by steam—with greater operating control and efficiency.

The installation at the Air Force Academy*, comprised of five C-E La Mont Controlled Circulation Hot Water Boilers, is the largest heating system of its kind in the nation, and is one of many such installations at large military bases, industrial plants and institutions.

Here then is another example of **C**reative **E**ngineering—the C-E approach to providing the most advanced designs of boilers for all fuel, heat and power requirements—from those of small plants to the largest power stations.

**Skidmore, Owings & Merrill, Architects • Syska & Hennessy, Inc., Associate Engineers*
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"CREATIVE ENGINEERING" is the reason for the leadership attained by C-E products. The products which bear this mark of leadership include:

all types of steam generating, fuel burning and related equipment · nuclear power systems · paper mill equipment · pulverizers · flash drying systems · pressure vessels · soil pipe

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MECHANICAL ENGINEERING

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THE COVER

The business end of an ICBM will disintegrate from shock and from 15,000 F temperature unless re-entry is made at optimum attitude. For accurate determination of re-entry attitudes, Dynametrics Corporation of Burlington, Mass., has produced this Weight and Center of Gravity Locator, shown in use by Avco for convenient readout of weight and center of gravity along the roll, pitch, and yaw axes of a nose cone. The Locator, so accurate it corrects for gravity variations, can be used in the field by untrained personnel.

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In the end, your education is what you know, wherever you learned it. As your career advances, will you be a well-informed man? Is management backing you up in your search for "total education"?

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For more information on how you can order B&W Job-Matched Pipe—and B&W Job-Matched Fittings — all from one source, call the tubing specialist at your local B&W District Sales Office. Or write for Bulletin TB-410. The Babcock & Wilcox Company, Tubular Products Division, Beaver Falls, Pennsylvania.

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ENGINEERING

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READERSHIP
RESEARCH

Figuring tubing materials on a cost per year basis?

NEW 4-D WROUGHT IRON costs less, lasts longer

The lower the cost per year, the more economical the investment. Especially so when the material lasts a long, long time. Take the cost comparisons below. Based on actual installations, users of wrought iron cold drawn tubing have been investing wisely for many years. Now, with new 4-D Wrought Iron available, your savings are even greater.

Note: New 4-D Wrought Iron was achieved by substantially increasing the deoxidation of the base metal, slightly increasing the phosphorous content and using a more siliceous iron silicate.

Result is *increased* corrosion-resistance, *improved* mechanical and physical properties.

INSTALLATION	COST PER FOOT PER YEAR	
	WROUGHT IRON	STEEL
Hotel, Brooklyn, New York Hot ammonia gas passing through interior of tubes, cooled by salt water circulating along outside of tubes.	$ .03 (19 years)	$ .24 (2 years)
Ice Company, Chicago, Illinois Carbon dioxide condenser service.	.03 (18 years)	.05 (10 years)
Film Corporation, Binghamton, New York Tubes used in cooling service.	.04 (15 years)	.06 (8 years)
Industrial Plant, New Bedford, Massachusetts Ammonia condenser with salt water in coolant.	.04 (12-14 years)	.48 (1 year)
Industrial Plant, Toronto, Canada Tube and shell type condenser used for cooling brine with ammonia.	.01 (50 years)	.07 (7 years)
Ice Company, Aiken, South Carolina Ammonia condensers with mild brine solution containing 76 ppm sodium chloride for cooling.	.03 (18 years)	.29 (2 years)
Ice Company, Rocky Mount, North Carolina Condensers with mild brine solution containing 75 ppm sodium chloride for cooling.	.07 (8 years)	.16 (3 years)
Industrial Plant, Wisconsin Vaporizers for production of butane and propane gas. Severe stresses created by wide temperature variances.	.28 (2 years)	.96 (6 months)
Oil Company, Long Island City, New York Cool, weak ammonia liquor cools hot, concentrated ammonia liquor coming from generator on the way to absorber.	.03 (20 years)	.07 (6-8 years)
Process Company, Detroit, Michigan Heat exchangers with ammoniated brine concentration of about 10% ammonia and salt almost to saturation point.	.08 (8 years)	.16 (3 years)
Gas Company, Brooklyn, New York Ammonia condenser with cooling medium of creek water contaminated by the refuse from several nearby industrial plants.	.05 (16 years)	.22 (3-5 years)
Alkali Company, Saltville, Virginia Heat exchanger carrying ammonia liquor that is subsequently cooled by surrounding water.	.05 (16 years)	.30 (6 mos.-3 years)
Industrial Plant, Chicago, Illinois Condenser tubes in absorption system. Ammonia inside the tubing is about 200°F. and water outside the tubes is about 40°F.	.09 (9-11 years)	.28 (3 years)
Electric Utility Company, Hunts Point, New York Gas cooler drawing water from East River in New York City.	.15 (8-9 years)	.45 (2-3 years)
Warehouse & Cold Storage Corp., Springfield, Massachusetts Ammonia condensers and direct expansion cooling coil.	.02 (30 years)	.04 (12 years)

"Cost per foot per year" figures are calculated from current prices of cold drawn seamless steel tubing (ASTM A-179) and cold drawn wrought iron tubing (ASTM A-382). Because of the many variables involved, costs for installation labor, maintenance and replacement are not included. If they were, wrought iron's low cost story would, of course, be even more impressive.

Details on any of the above installations furnished on request. Write for Wrought Iron Heat Exchanger and Condenser Tubing bulletin.

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Corrosion costs you more than Wrought Iron

...now from WICKES
a new 100,000 lb. per hour capacity shop-assembled natural circulation boiler

Wickes Type A units are of simple design, ruggedly constructed and adaptable to a variety of operating conditions and may be fired with oil, gas or combination of both.

All units are shipped completely shop-assembled including superheater, fuel burning equipment, safety and combustion controls, forced draft fan and drive, soot blowers and feedwater regulator.

Save on

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- **Operating Expense**
- **Space**
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For more detailed information on Wickes Type-A steam boilers, write for our catalog 56-1. Bulletin 55-1 covers the complete line of Wickes Products and Facilities.

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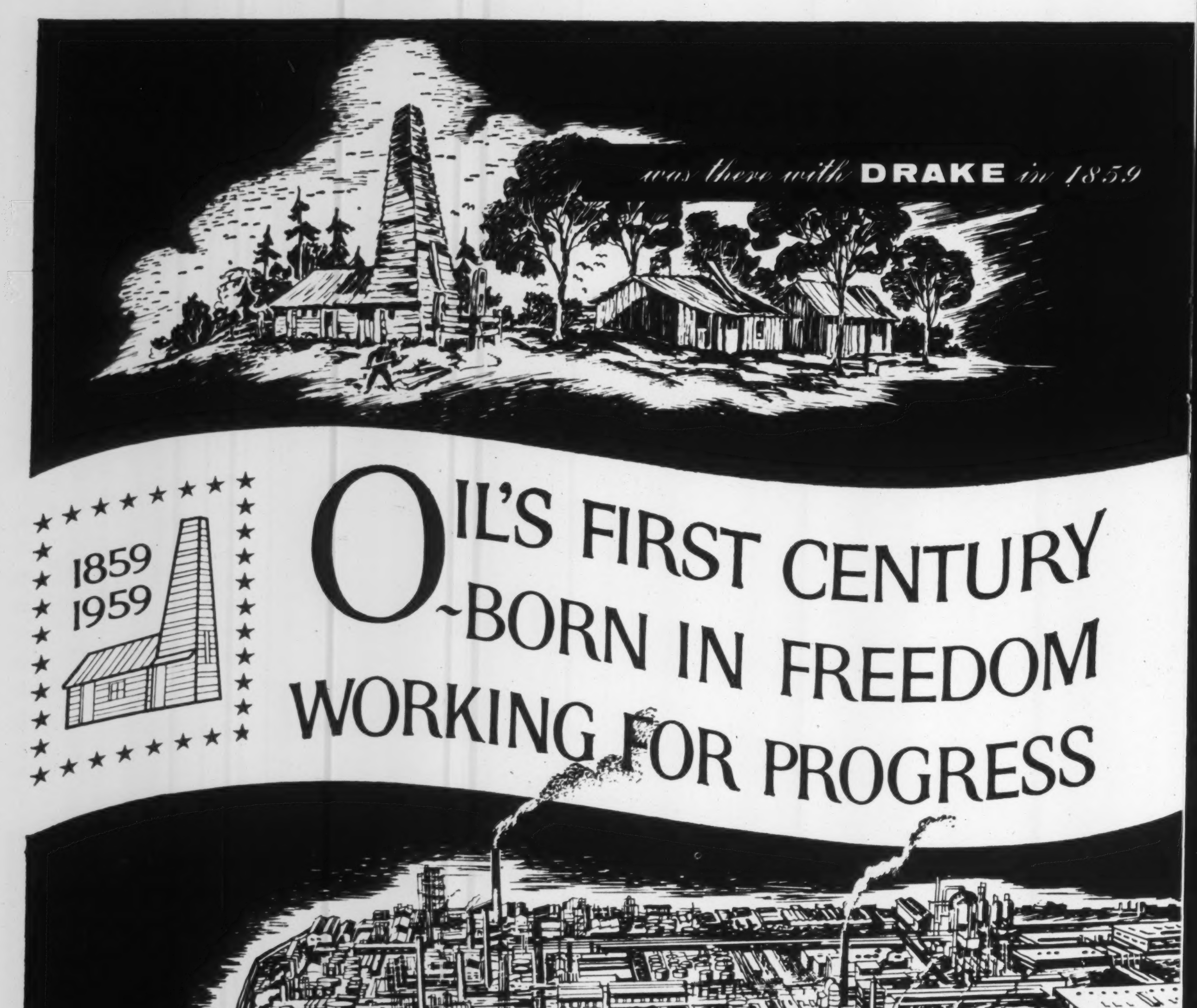
was there with DRAKE in 1859
1859
1959
OIL'S FIRST CENTURY
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WORKING FOR PROGRESS
ERIE CITY is here in 1959

IN the beginning there was a dreamer and a dream. The dreamer was Col. Edwin L. Drake - - - his dream was to drill the first oil well in the history of the world so the collection of oil could be simplified. To accomplish this end he needed a small boiler and a steam engine. These first pieces of steam power equipment were supplied to Col. Drake by a then relatively small progressive foundry and machine shop - - - Erie City Iron Works.

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Grinnell Constant Supports are the result of a century of experience in the industrial piping field. A patented geometric design, exclusive with Grinnell Constant Supports, assures mathematically perfect load support throughout all positions of travel. There is also a full 70 percentage points of adjustability built into them. No less than 10 percent of this adjustability is allowed either side of calibration for plus or minus change in load. Field readjustments are easily made by turning a single load adjustment bolt. These hangers are designed to provide uniform supporting force equal to the pipe load throughout the travel range — and should be used at selected points on critical lines, as for example at turbine connections.

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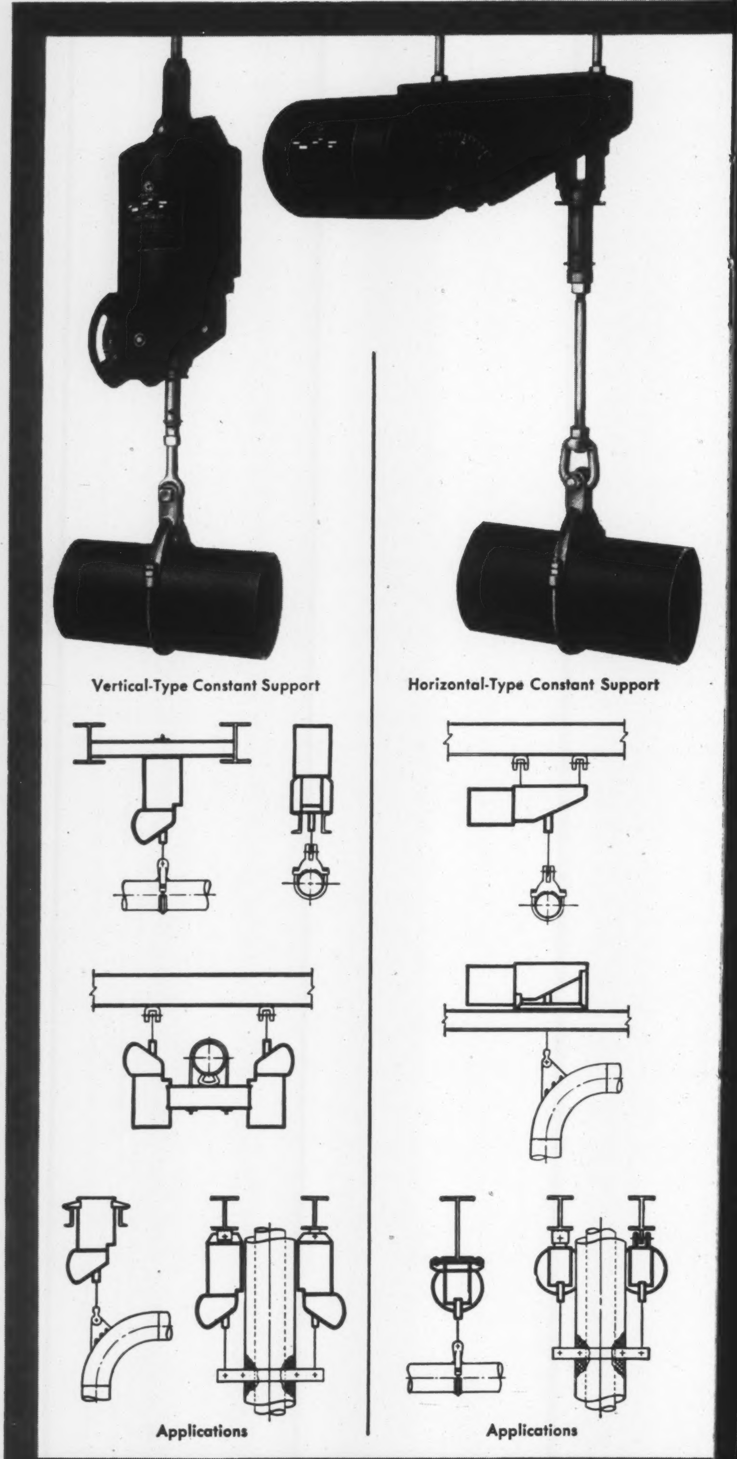
Grinnell Constant Supports are available in eleven types for a complete choice of mounting positions; above, between, or below structural steel. This choice includes both vertical and horizontal design to fit compactly into available headroom space. Even with this wide choice, Grinnell Constant Support Hangers provide mathematically perfect support through *all* ranges of travel, regardless of field adjustments.



Vertical-Type Constant Support

Horizontal-Type Constant Support

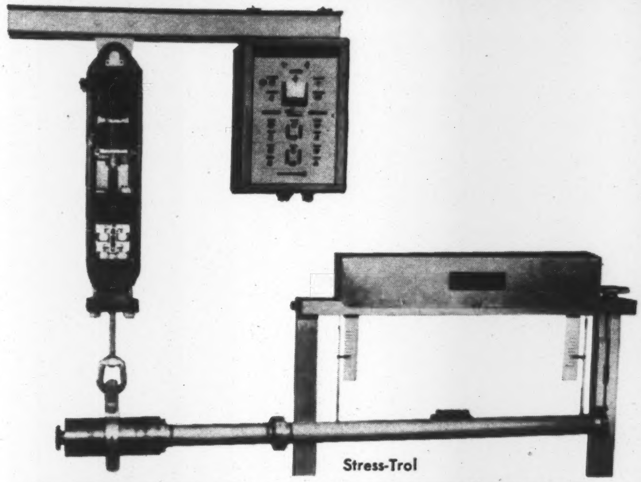
Applications

Applications

GRINNELL

AMERICA'S No. 1 SUPPLIER OF
PIPE HANGERS AND SUPPORTS

hangers to provide for thermal expansion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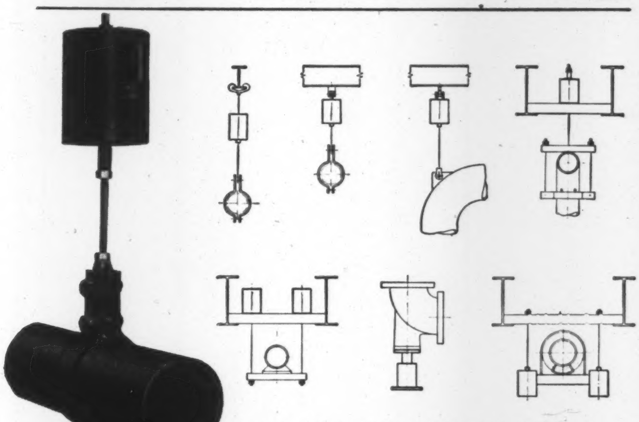
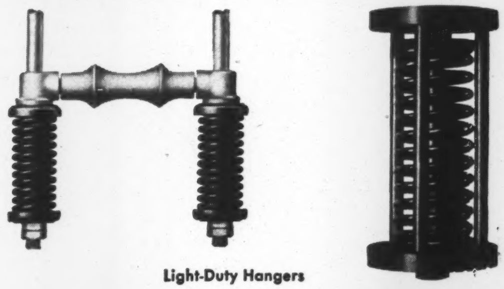

Variable Spring Hangers and Applications

Vibration Control and Sway Brace


Light-Duty Hangers

GRINNELL STRESS-TROL* FOR POSITION AND/OR LOAD CONTROL

Keeping the footage of high pressure-high temperature fabricated piping to a minimum has become important because of high piping costs. This can be accomplished by reducing the length of long expansion bends, but providing support for shorter, less flexible lengths of piping presents a new problem. Grinnell Stress-Trol, a motor operated device, solves this problem. It provides:

Position Control — that minimizes stresses in piping and reactions on connected equipment.

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When pipe lines are subject to relatively small vertical movement, and do not require a constant support type hanger, Grinnell Variable Spring Hangers are available. The maximum variation in supporting force for standard spring models per ½ inch deflection is 10% of rated capacity. Grinnell offers these hangers in 21 sizes — in short, standard and double spring models, plus a special corrosion-resistant model. There are 7 different methods of attachment.

GRINNELL VIBRATION CONTROL AND SWAY BRACE

When necessary to prevent undesirable movement in lines, Grinnell Vibration Controls and Sway Braces of the energy storing and instant-acting counter force type are recommended. They dampen vibration, oppose pipe sway and absorb shock.

GRINNELL LIGHT-DUTY SPRING HANGERS

Finally, simple and inexpensive adjustable light-duty spring hangers often are all that's required to support piping safely. Grinnell has a complete line of light-duty hangers. They are designed for easy installation and quick, accurate alignment of piping.

Whatever your pipe suspension needs, Grinnell can supply them. Grinnell Company, 260 West Exchange Street, Providence 1, Rhode Island.

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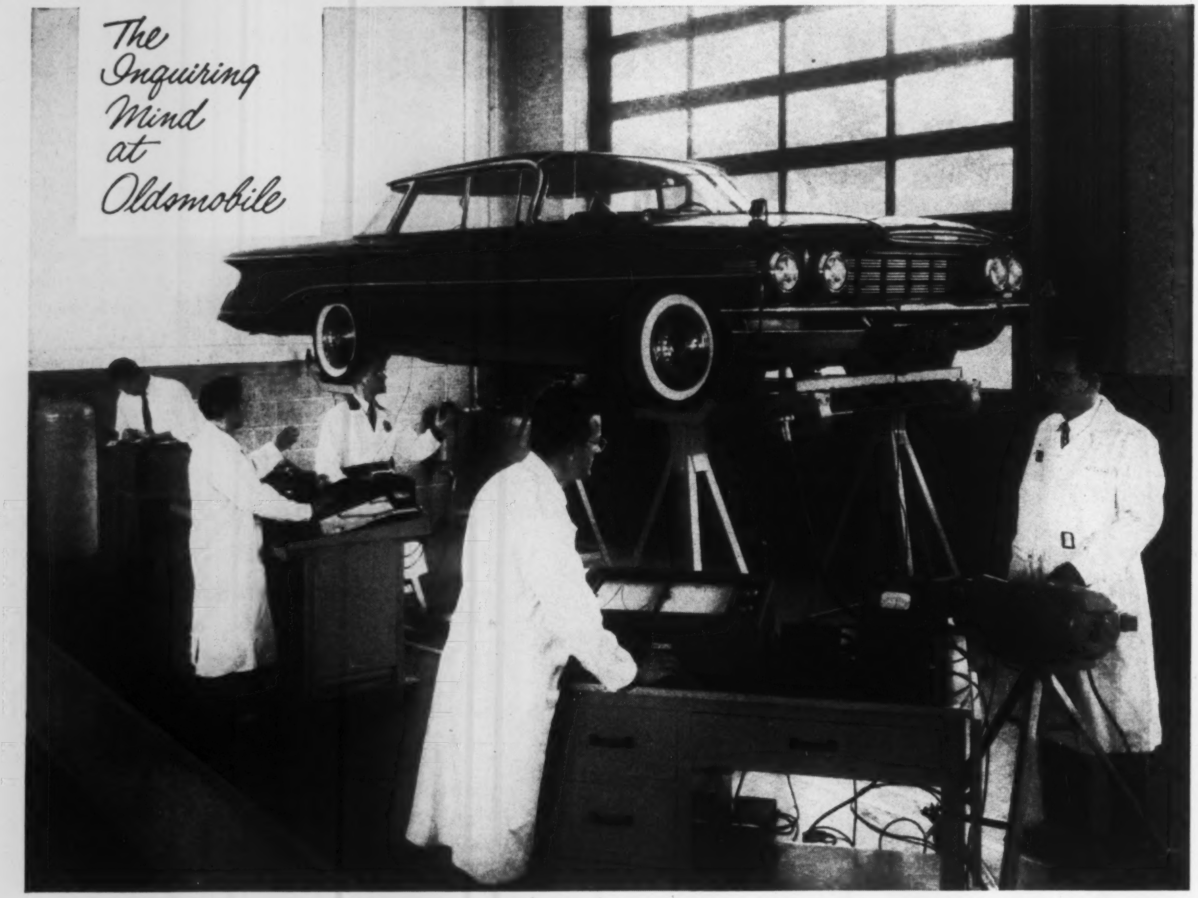
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IT'S THE QUIETEST RIDE YOU'VE EVER TRIED!

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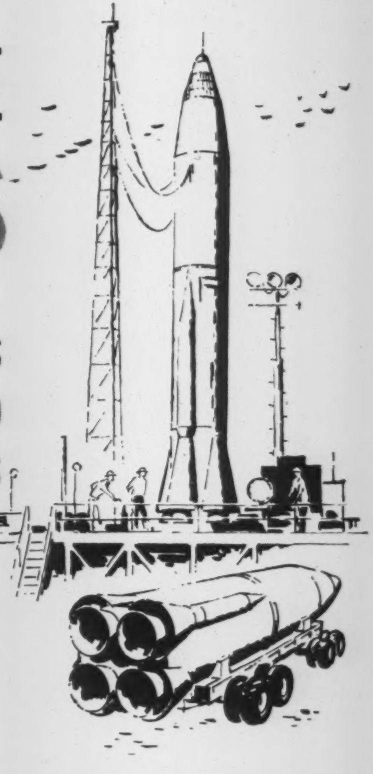
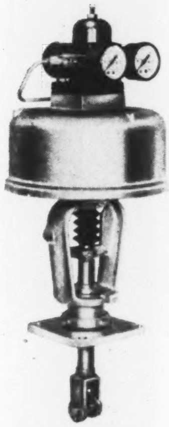
OLDSMOBILE **Where Proven Quality is Standard!**

Annin OFFERS YOU MORE IN ACTUATORS

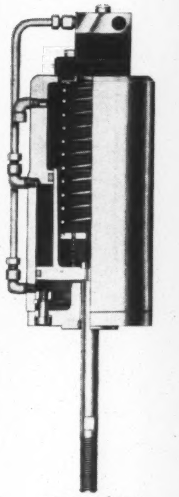


Your choice OF ADVANCED DESIGNS WITH MORE PRECISE POSITIONING AND DYNAMIC RESPONSE CHARACTERISTICS



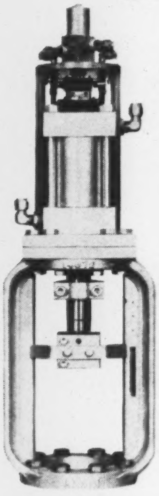
1542 & 1544 SERIES DOMOTOR POWERED ACTUATORS

Two types, "Direct Thrust" (illustrated) or "Lever" units are available for any application requiring accurate positioning in response to a pneumatic signal, such as butterfly valves, dampers, turbines and engine governors. Guaranteed positioning accuracy of better than 0.001" per inch of stroke over the complete range of piston travel is combined with a smooth operating action that provides an accurate, stable output force.



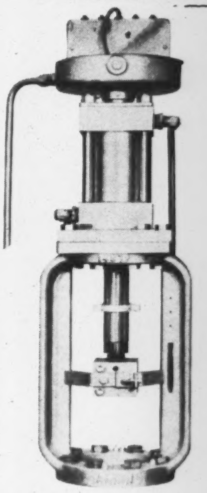
600 SERIES STROKE POSITIONING ACTUATORS

Offered primarily for the control of variable speed drives, rheostats, pumps and cams, as well as control valves, with strokes up to 6 inches and forces up to 2510 pounds of thrust. Compact and rugged, for easy mounting on existing equipment. May be operated from a standard 3-15 psi instrument signal, with a positional accuracy within 0.001" per inch of stroke.



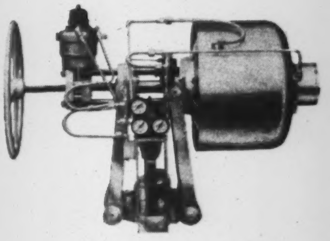
10,000 SERIES PNEUMATIC-HYDRAULIC ACTUATORS

For valves requiring strokes to 6 inches and thrusts to 100,000 lbs. Furnished on body assemblies where process conditions require very fine valve response, hi-speed and stability. Operate on 1500 psi oil supply system from any common instrument air signal.



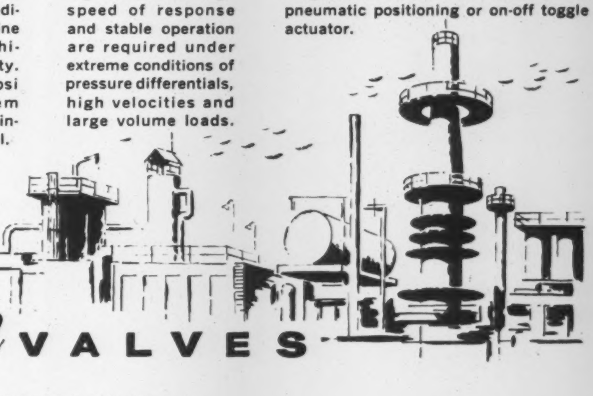
20,000 SERIES ELECTRO-HYDRAULIC ACTUATORS

Provide a means of converting an electrical signal to a powerful hydraulic positioning force, where high speed of response and stable operation are required under extreme conditions of pressure differentials, high velocities and large volume loads.



TOGGLE ACTUATORS

For process requirements where the unbalanced forces are extremely high, or where large through-puts are required. Three types are offered: pneumatic positioning, pneumatic on-off, and manual control, all embodying the toggle actuator; or a manual control arrangement can be combined with the pneumatic positioning or on-off toggle actuator.



Annin VALVES

THE ANNIN COMPANY

Write for Bulletin 1236-ST

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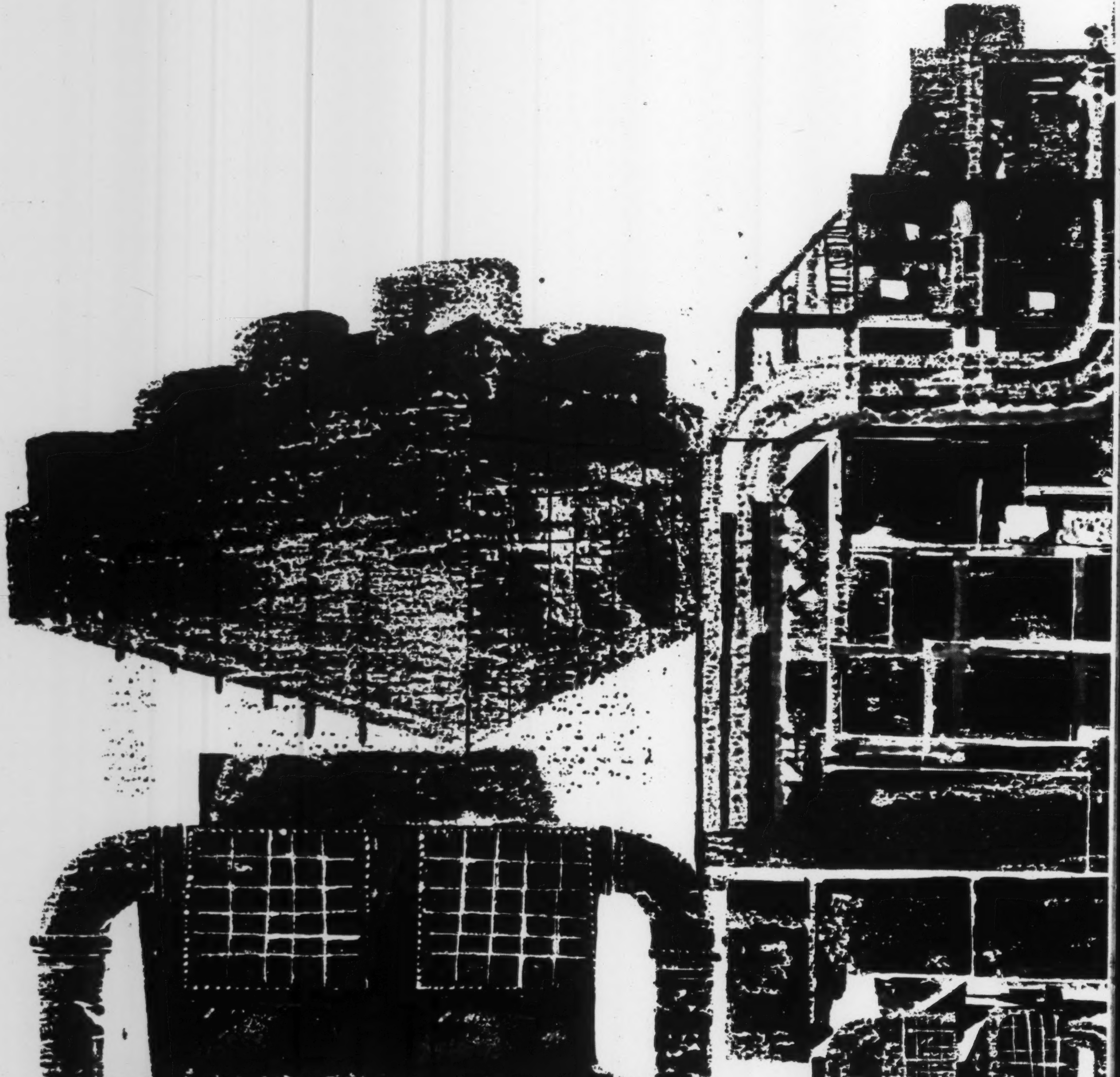
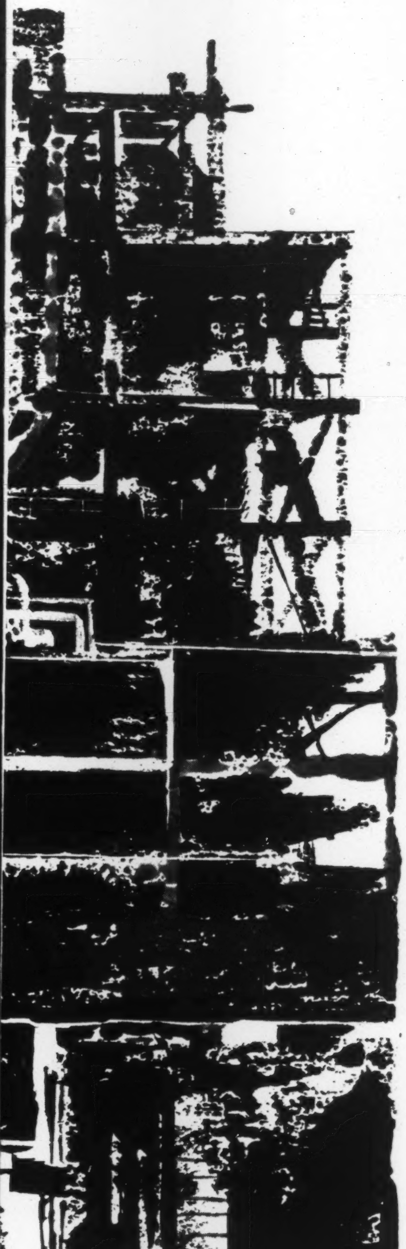


POWER PLANT PRODUCTS HEAT ENGINEERED BY FOSTER WHEELER:

Central Station and Industrial Steam Generators • Steam Condensers and Pumps • Pulverized Fuel Systems • Feedwater Heaters • Packaged Steam Generators • Cooling Towers • Nuclear Components



The one kind of engineering every plant needs

You may use heat to produce steam, electricity, or chemical reactions—but if you use it for any industrial purpose at all, heat is probably one of your major items of operating expense. There's also a good chance that heat is costing you more than it should.

That's because every piece of equipment that uses heat—be it a steam generator, heat exchanger, or simply piping—is a potential weak spot in your budget unless it is engineered to get the *optimum* out of the heat-dollars you put into it. At Foster Wheeler, getting the *most* out of heat is expressed as *Heat Engineering.*

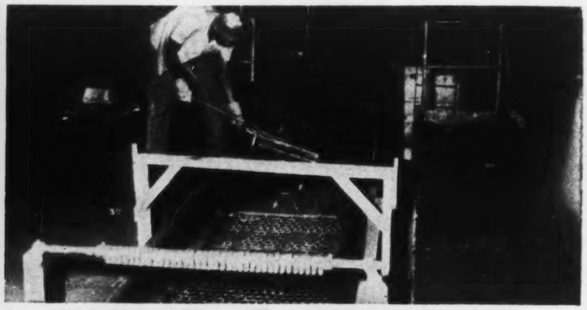
Heat Engineering is the reason you'll see FW-built equipment in such critical places as nuclear power stations, on the world's largest and most efficient tankers and naval ships, in giant steam-electric plants, and refineries and chemical process plants of all types and sizes.

If your company is contemplating *any* modernization, expansion, or replacement where heat is concerned, why not check into the difference *Heat Engineering* can make? Contact Foster Wheeler Corporation, 666 Fifth Avenue, New York 19, N. Y.

Heat Engineered products, plants and processes . . . for the world's industrial progress.

FOSTER WHEELER

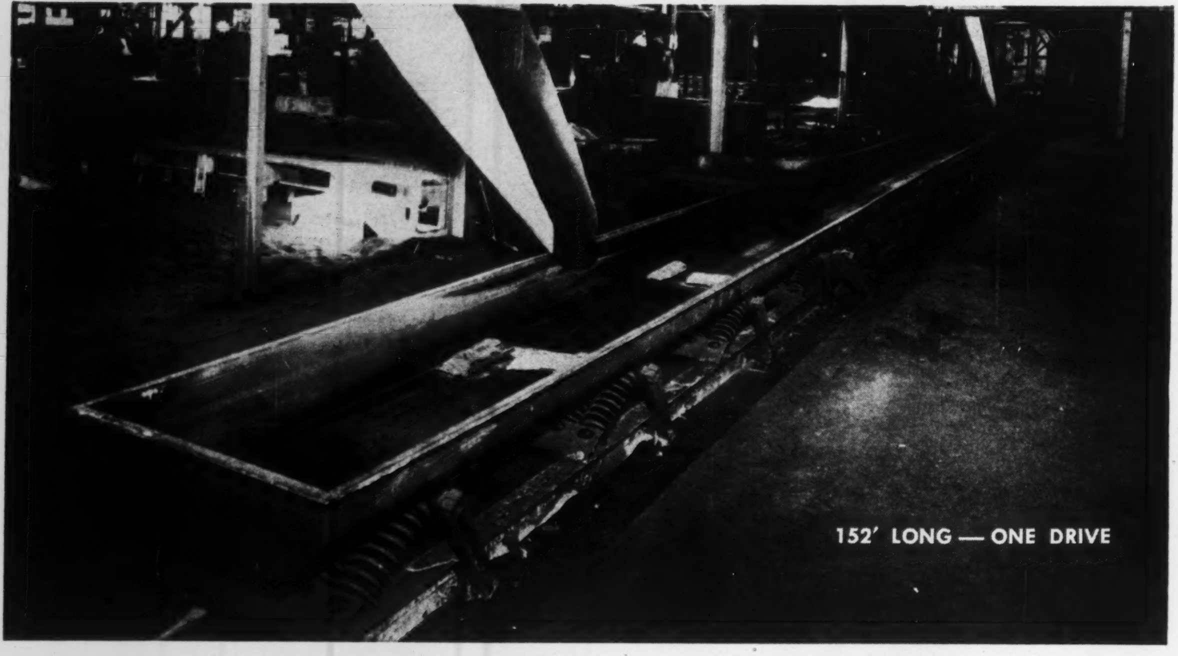
NEW YORK LONDON PARIS ST. CATHARINES, ONT.



RUGGED ▶▶ VERSATILE

Impact of hot sand, castings no problem.

Built-in shakeout with lump-breaker separates sand and castings.



152' LONG — ONE DRIVE

IN NASHVILLE FOUNDRY:

Special Shakeout-Conveyor lowers handling costs

This Carrier Natural-Frequency shakeout conveyor—152-feet long with a single 30 H.P. drive—has been installed in the foundry at Phillips & Buttorff Manufacturing Co., Nashville, Tenn., to replace a system of hand shakeouts and belt conveying.

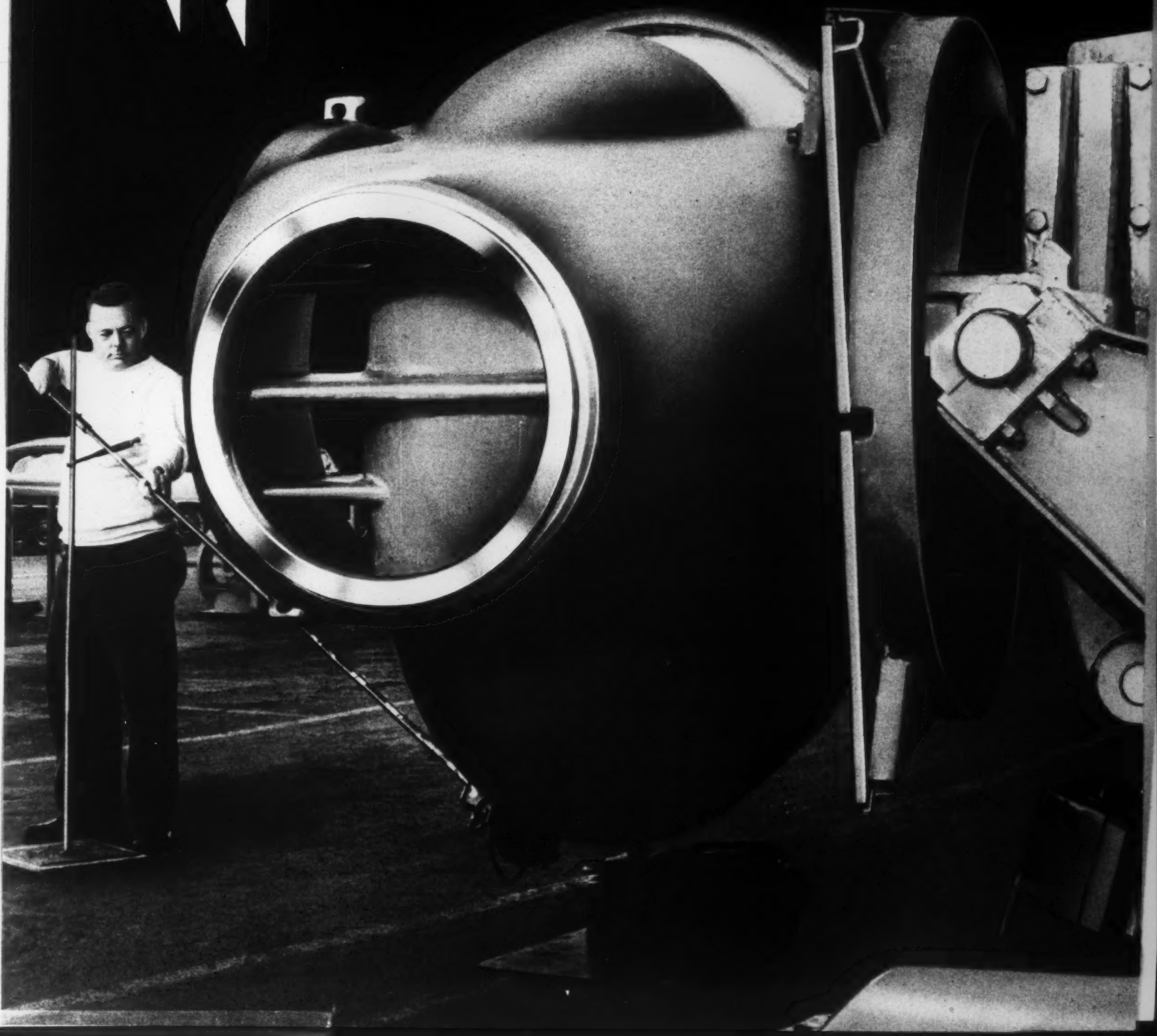
Result: The new Carrier Conveyor has greatly reduced labor costs, equipment downtime and sand spillage. It produces cleaner castings, requires less manpower and generally provides a more efficient operation than was previously possible.

Once the requirements were outlined by Phillips & Buttorff's engineering department, Carrier custom-designed this conveyor to improve the system for handling sand and castings. The conveyor's simple, rugged construction plus a special built-in shakeout section are perfect examples of Carrier's versatile engineering service.

CARRIER
~~NATURAL-FREQUENCY~~®
VIBRATING EQUIPMENT
Engineering Specialists in Vibrating Equipment

Write for General Equipment Bulletin: Carrier Conveyor Corporation, 225 North Jackson Street, Louisville 2, Kentucky

BJ Pumps
for all
Nuclear Fluids



BJ Specialists in solving

The special pumping demands of nuclear installations—whether stationary, portable or mobile—are actually a combination of many different, and usually difficult specifications.

To satisfy these complex requirements, Byron Jackson uses the same basic skills and methods which have made BJ a leader in the design and manufacture of special engineered pumps of all types for most of its 86 year history.

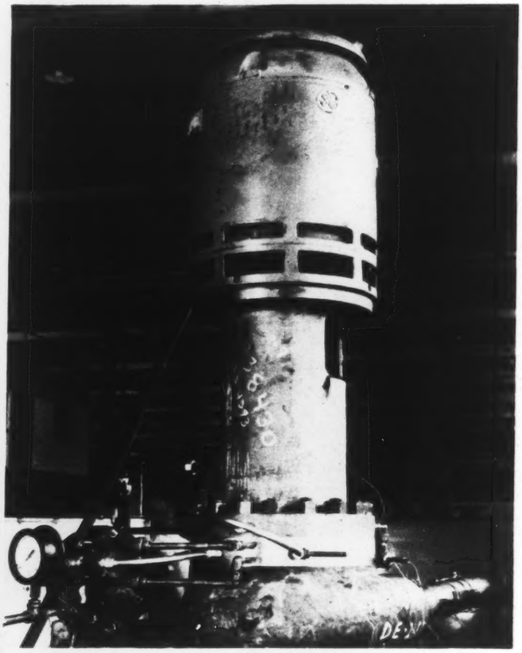
Shown below are some actual requirements for nuclear pumps which BJ engineers have successfully solved. One of these, or one of the many other BJ installations may be similar to your own needs. Our engineers always welcome the opportunity of discussing them with you.

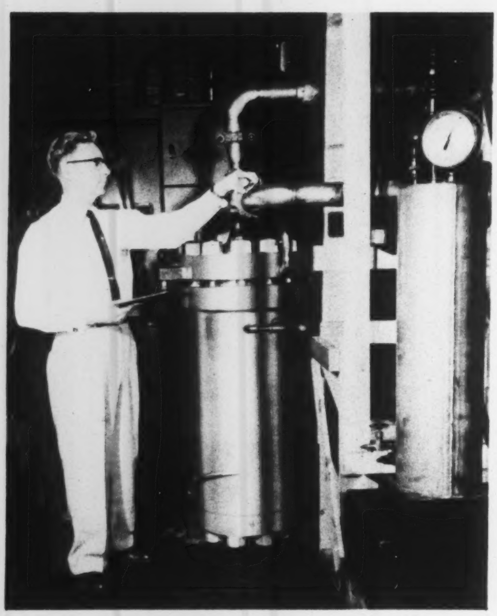
Problem:

HIGH PRESSURE AND HIGH TEMPERATURES both were required operating conditions, along with maximum pump reliability and economy for the Dresden Nuclear Power Plant of the Commonwealth Edison Company.

Solution:

Shown here on a hot loop test in BJ's laboratory before delivery, this mechanically-sealed pump meets all specifications of handling de-mineralized water to 1250 psig suction pressure and at temperatures to 574°F. It delivers 1700 gpm at 130 foot total discharge head.





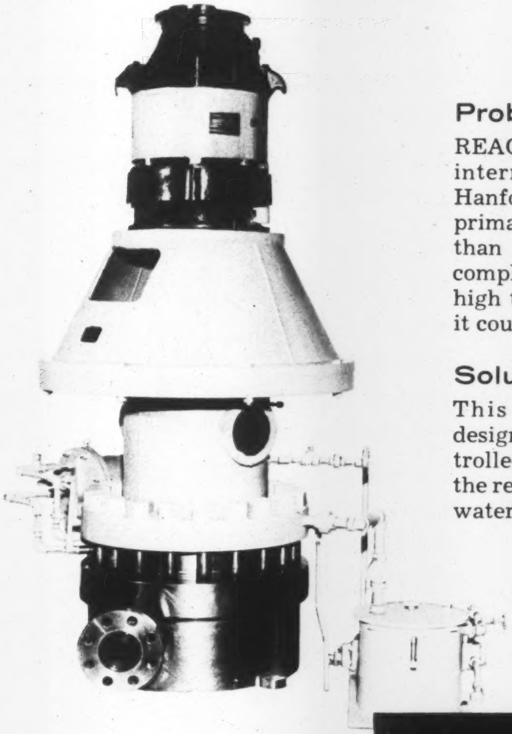
Problem:

SELF-VENTING ZERO LEAKAGE pump for high pressure, high temperature operation on General Electric's Hanford experimental water loop.

Solution:

The BJ hermetically-sealed liner-motor design with double thrust bearings allows self-venting inverted operation of this 45 H.P. pump for dependable, zero leakage performance at 2500 psig, 650°F.

Nuclear Pumping Problems

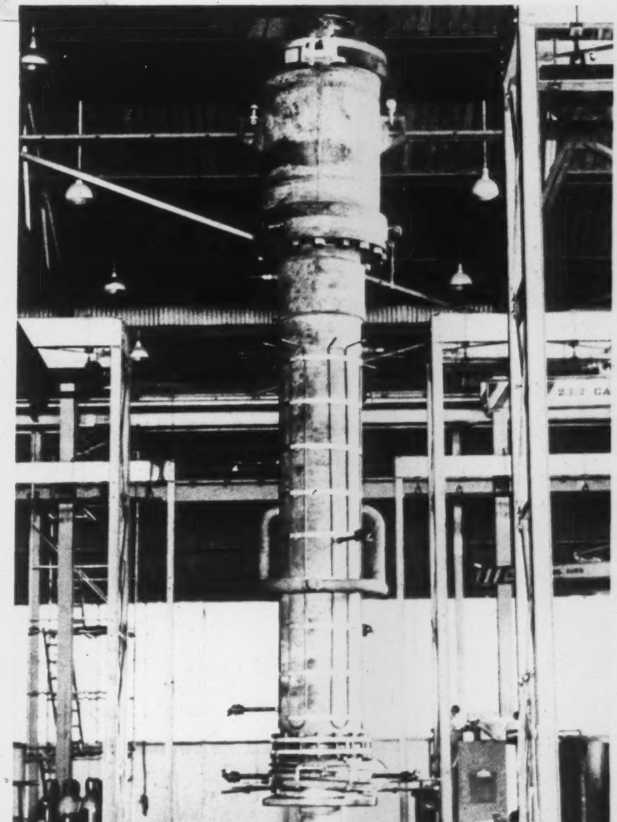


Problem:

REACTOR SAFETY—In the event of a power interruption or failure on General Electric's Hanford Plutonium Recycle Test Reactor, the primary coolant pump would decelerate faster than the automatic control mechanism could complete the reactor shutdown action. A critical high temperature condition could occur before it could be corrected.

Solution:

This BJ Mechanically-Sealed Pump was designed with an integral flywheel for a controlled decay curve, assuring circulation until the reactor is safely shut down. It handles heavy water at 550°F under 1500 psig.



Problem:

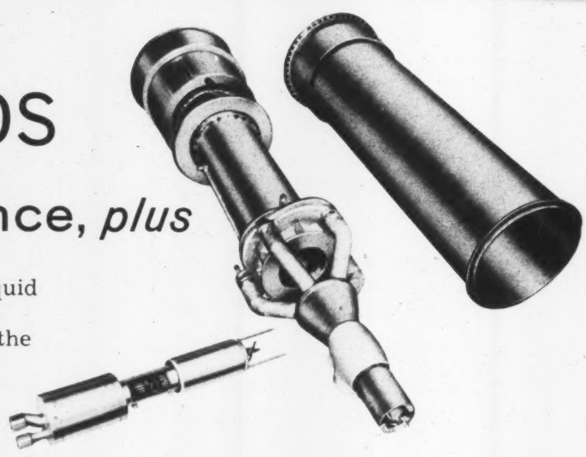
PUMPING 1000°F BISMUTH—with zero cover gas leakage posed a problem for the Brookhaven National Laboratory. An important additional requirement was a practical means of inspection and maintenance.

Solution:

Using a hermetically-sealed, gas-filled motor, this BJ design accommodates the entire bismuth expansion at all system temperatures, and requires no liquid level controls. Its full length pull-out construction allows simplified removal by remote handling equipment for maintenance or inspection.

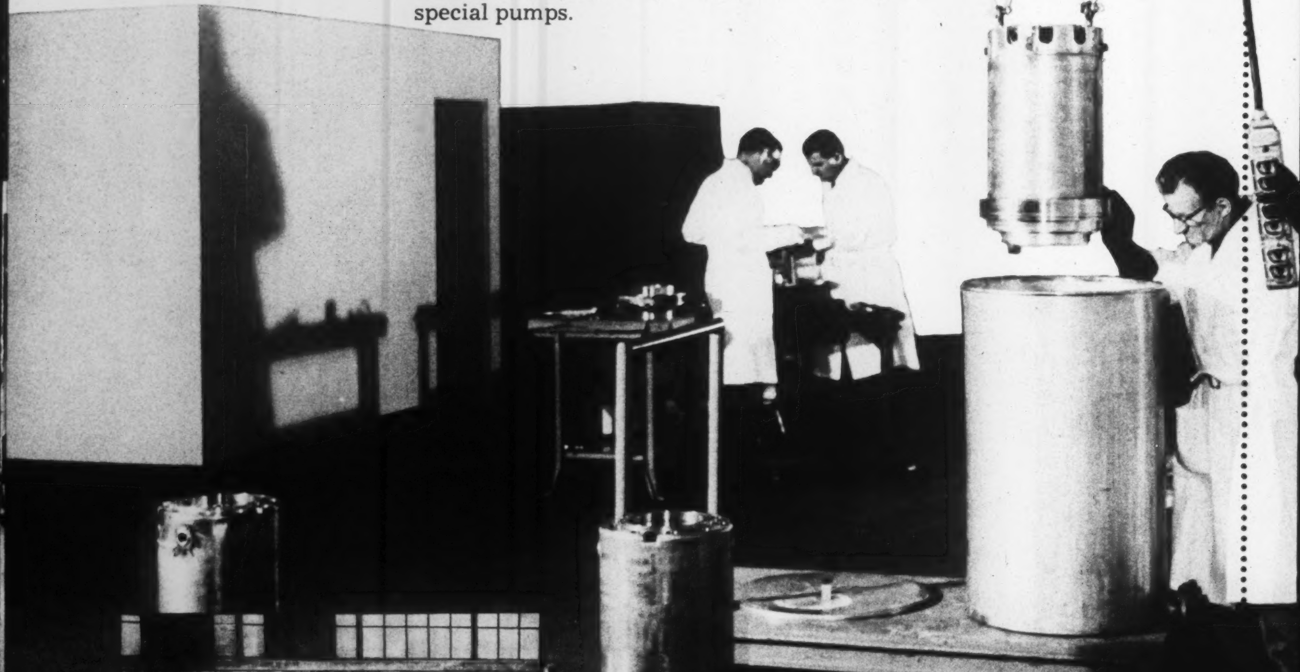
Nuclear Pumps

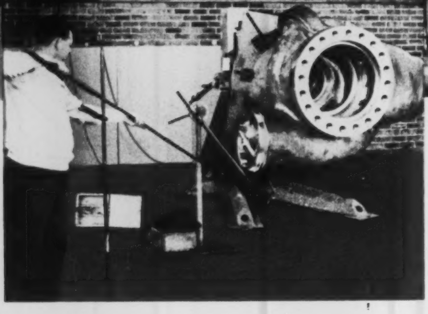
Byron Jackson experience, *plus*



...special designs From the world's largest liquid sodium pumps—(three 1000 HP, 12,000 gpm units)—to a compact ¼ HP liner-motor unit—BJ designs for the job. The success of these nuclear pump designs is proved through the installation or specification of BJ pumps on every major commercial reactor in the United States.

...special equipment Completely dust-free environment is provided in Byron Jackson's modern "clean room" assembly facility for nuclear and special pumps.





...special techniques This radiographic X-ray is only one of the continuous inspections that insure reliable performance. Special welding, helium leak testing, and BJ's hydraulic hot and cold test loops provide further quality control.

Byron Jackson Pumps, Inc.

SUBSIDIARY OF BORG-WARNER CORPORATION
P.O. Box 2017, Terminal Annex, Los Angeles 54, Calif.
Telephone LUdlow 7-6171

BJ

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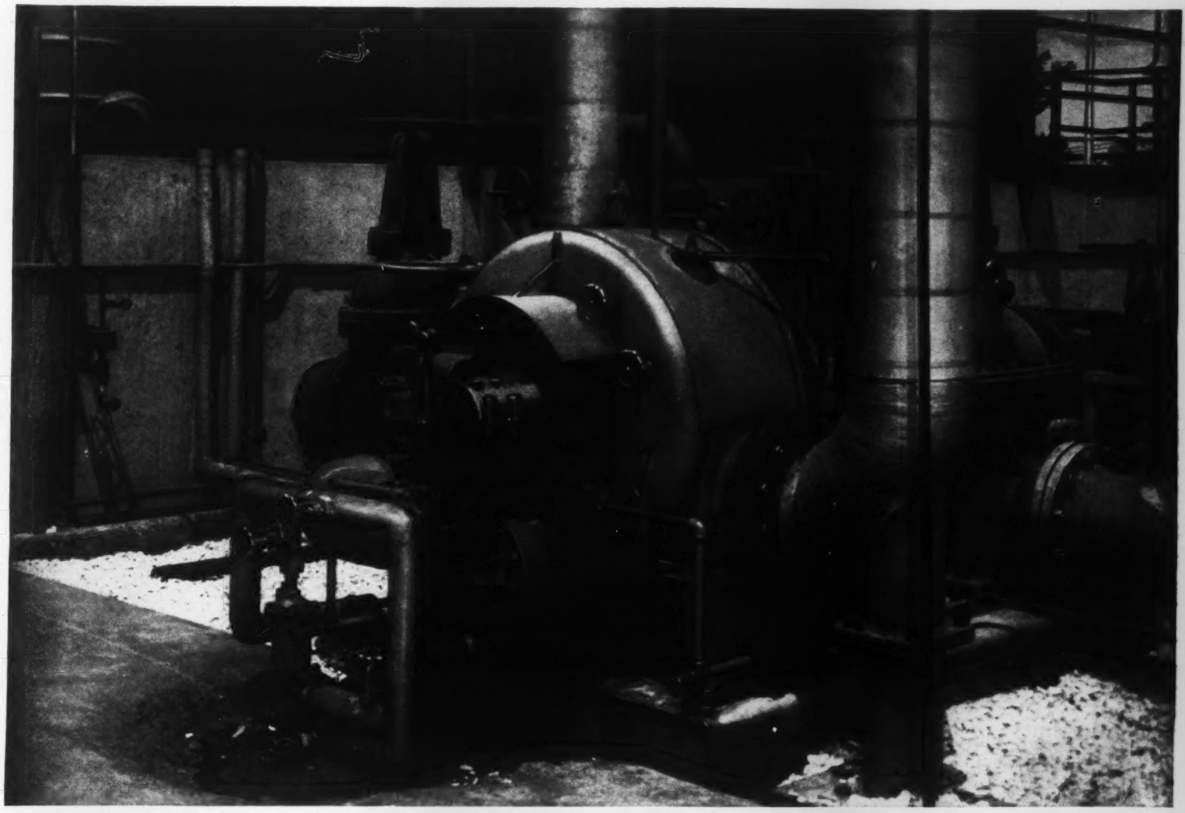
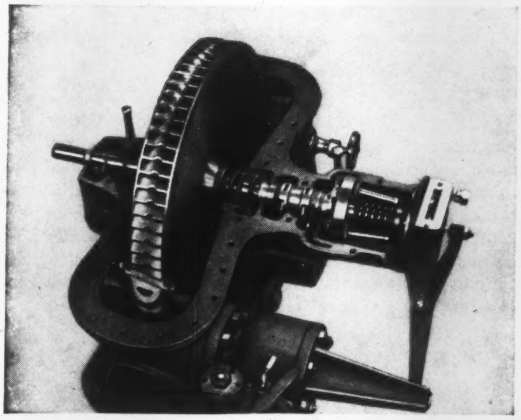


TERRY SOLID-WHEEL TURBINES

used exclusively at Baton Rouge plant of W.R.Grace & Co.



The upper photograph shows one of the 17 Terry turbines installed at the Baton Rouge, La., GREX high-density polyethylene plant of W. R. Grace & Co. Above, a typical Terry solid-wheel turbine with cover removed to show the wheel construction.

In purchasing equipment for their new 50,000,000-pound high-density polyethylene plant, W. R. Grace & Co. standardized, wherever possible, on a single source of supply for each type of equipment used. Consistent with this policy, Terry steam turbines were used exclusively throughout the utility and process sections of the plant.

A total of 17 turbines were placed in service for driving pumps and fans. These are all of the solid-wheel type, ranging in capacity from 50 to 240 HP.

Terry solid-wheel turbines are known for their long life and sure dependability under the most-trying operating conditions. They feature a single-piece wheel which is virtually indestructible.

Send for details of these trouble-free turbines. Ask for a copy of bulletin S-116.

THE TERRY STEAM TURBINE COMPANY
TERRY SQUARE, HARTFORD 1, CONN.

TERRY

TT-1214

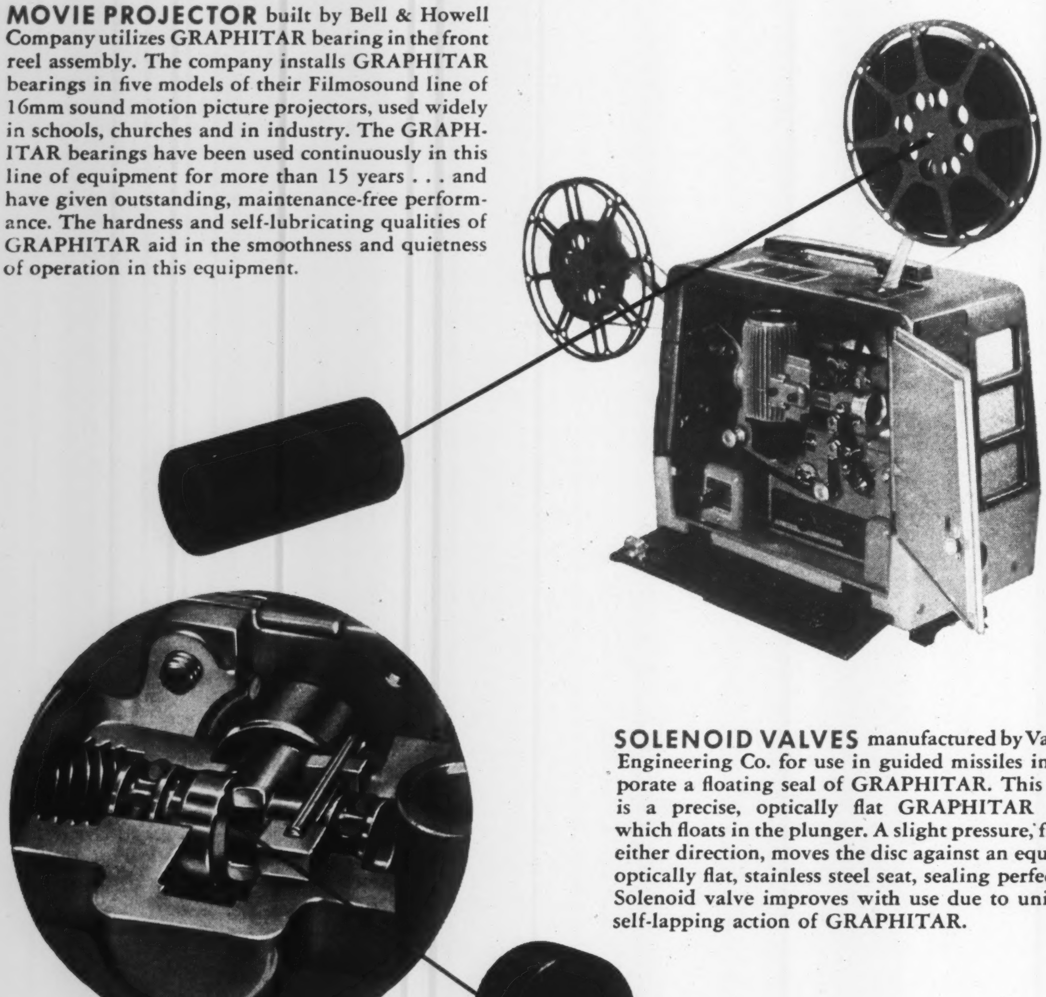
this is GRAPHITAR®

(CARBON-GRAPHITE)

• •

successful in a wide variety of applications

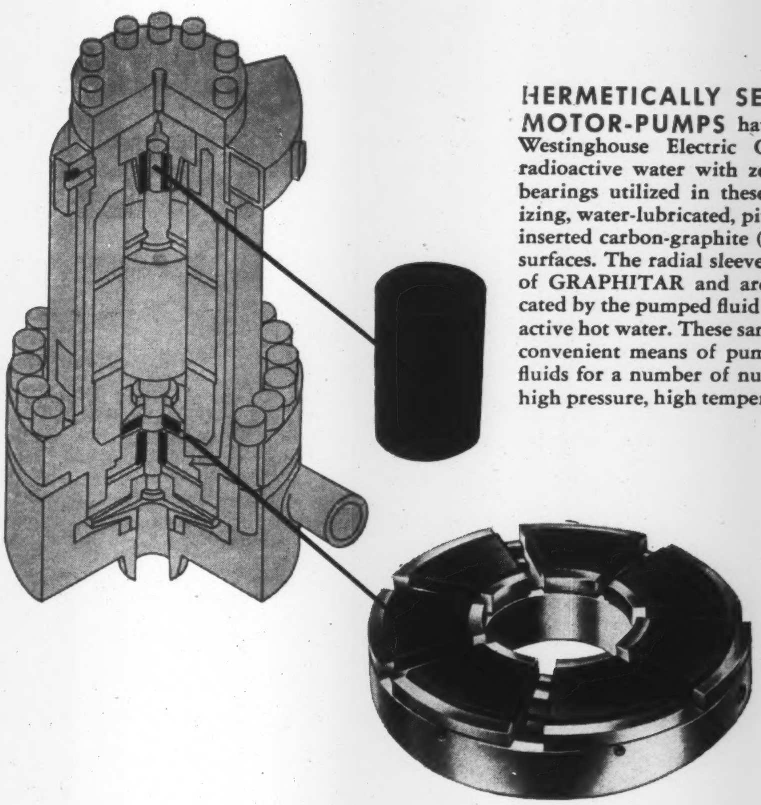
MOVIE PROJECTOR built by Bell & Howell Company utilizes GRAPHITAR bearing in the front reel assembly. The company installs GRAPHITAR bearings in five models of their Filmosound line of 16mm sound motion picture projectors, used widely in schools, churches and in industry. The GRAPHITAR bearings have been used continuously in this line of equipment for more than 15 years . . . and have given outstanding, maintenance-free performance. The hardness and self-lubricating qualities of GRAPHITAR aid in the smoothness and quietness of operation in this equipment.



SOLENOID VALVES manufactured by Valcor Engineering Co. for use in guided missiles incorporate a floating seal of GRAPHITAR. This seal is a precise, optically flat GRAPHITAR disc which floats in the plunger. A slight pressure, from either direction, moves the disc against an equally optically flat, stainless steel seat, sealing perfectly. Solenoid valve improves with use due to unique self-lapping action of GRAPHITAR.

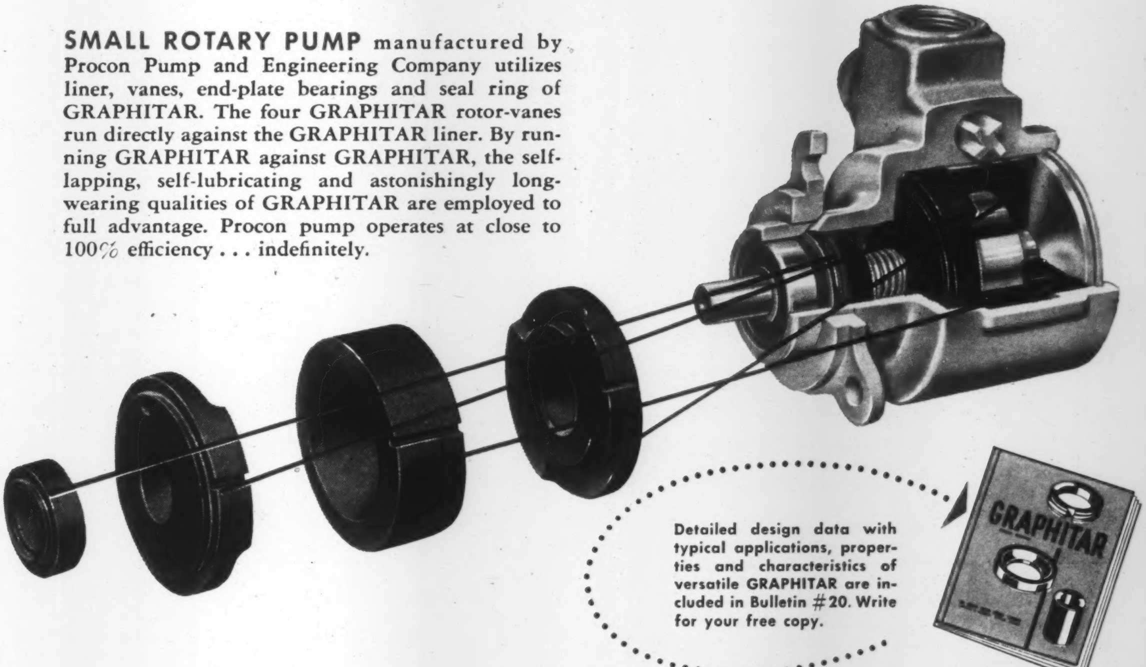
THE UNITED STATES

GRAPHITAR® CARBON-GRAPHITE • **GRAMIX®** POWDER METALLURGY • **MEXICAN®** GRAPHITE PRODUCTS • **USG®** BRUSHES



HERMETICALLY SEALED MOTOR-PUMPS have been developed by Westinghouse Electric Corporation to handle radioactive water with zero leakage. The thrust bearings utilized in these pumps are self-equalizing, water-lubricated, pivoted-pad bearings with inserted carbon-graphite (GRAPHITAR) bearing surfaces. The radial sleeve bearings are also made of GRAPHITAR and are designed to be lubricated by the pumped fluid only, in this case, radioactive hot water. These same pumps have proven a convenient means of pumping high temperature fluids for a number of nuclear reactors and other high pressure, high temperature fluid applications.

SMALL ROTARY PUMP manufactured by Procon Pump and Engineering Company utilizes liner, vanes, end-plate bearings and seal ring of GRAPHITAR. The four GRAPHITAR rotor-vanes run directly against the GRAPHITAR liner. By running GRAPHITAR against GRAPHITAR, the self-lapping, self-lubricating and astonishingly long-wearing qualities of GRAPHITAR are employed to full advantage. Procon pump operates at close to 100% efficiency . . . indefinitely.



Detailed design data with typical applications, properties and characteristics of versatile GRAPHITAR are included in Bulletin #20. Write for your free copy.

R-265-2

GRAPHITE COMPANY

DIVISION OF THE WICKES CORPORATION, SAGINAW 4, MICHIGAN

Expansion Joint Design Moves out of the "Model T" Era

Badger first began fabricating packless metal bellows expansion joints more than 35 years ago. These "Model T" joints performed (and are still performing) with outstanding success in hundreds of process and steam line piping installations.

Starting in the 30's other expansion joint manufacturers entered the field. The most successful adopted many of the basic features of the original Badger design.

During the last decade, as industry's requirements became more stringent, and joint manufacturers gained fabricating and field experience, certain fundamental problems inherent in the early designs became evident. Most of these problems were solved through a series of modifications. (Among which was the Badger Directed Flexing Self-Equalizing Joint — the famous "DFSE" Design.) But, at best, the modifications were stop-gap measures which complicated the joints and greatly increased their weight. A fundamental reassessment of expansion joint engineering data was needed. Badger led the way: In 1956, a task force completed a three-year research program and the first S-R (Service-Rated) Expansion Joints were produced.

In the three years they have been available, S-R Expansion Joints have been both an engineering and a sales success. But like many revolutionary concepts which upset tradition, the full implication of the advantages S-R Joints offer is still not universally understood. The message that follows is an attempt "to set the record straight."

• • • • •

Equalization — fact and fiction

Many users of expansion joints are under the impression that the so-called "equalizing" rings on today's conventional type expansion joints distribute movement equally among all the corrugations of the bellows. It is argued that as the joint absorbs thermal movement, the tops of the rings progressively come into contact until the bellows is fully compressed thus limiting the amount of compression which any one corrugation can ultimately absorb (see diagram 1). In *this* sense the rings do contribute to the "equalization" of movement by physically limiting the compression of each corrugation to the distance between any two adjacent rings.

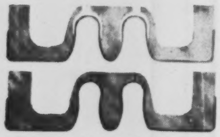


Diagram 1

Conventional Type Expansion Joint. Cross-sections of rings and bellows of a conventional "self-equalizing" joint showing cold and hot positions. Note that true equalization of movement can only be obtained when tops of all rings are in contact — an impractical and dangerous situation.

Note, however, that the degree of compression will not be truly equalized until the tops of all the rings are in contact. But, when such a condition occurs, serious problems will result. If the limit of compressibility is reached before the thermal expansion has been completely absorbed, exceedingly large forces will be transmitted through the pipe line to the anchors and connected equipment. On the other hand, if the joint is compressed only partially, not all of the corrugations will absorb movement to the same degree.

How S-R Joints solve equalization problem

Badger S-R Expansion Joints feature the new Curvilinear Corrugations which naturally assume an "all curve" shape under pressure (diagram 2), assuring more equal distribution of stresses throughout the bellows material. Furthermore, the shape, height and pitch of the corrugations are based on a carefully engineered correlation. Thus, reasonably equal distribution of movement among the corrugations is obtained, even in joints not equipped with reinforcing rings.

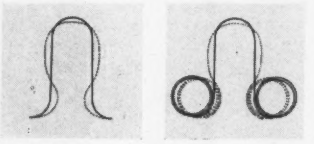


Diagram 2

Badger S-R Expansion Joint. Cross-sections of S-R Joints (Series 50 left, Series 150 right). The movement of the corrugations is shown by dotted and solid lines. Compare configuration and effective height of corrugations, position and size of rings with conventional joint.

Equalization of movement is inherent in the design and functioning of the bellows on Badger S-R Joints. On the basis of provable engineering criteria, the prime purpose of reinforcing rings of any design is to retain the hoop dimension (diameter) of the corrugations when they are subject to internal pressure. This Badger's simple, lightweight tubular reinforcing rings do. But, in addition, the new tubular shape of the rings does contribute to joint flexibility and life by permitting flexing over a more effective portion of the total corrugation height than conventional cast or fabricated equalizing rings.

Better performance, lower cost

Briefly, then, Badger S-R Joints alone offer these advantages: Better equalization of movement which results in elimination of localized stresses and leads to longer joint life; a simple, lightweight design that makes installation easier, eliminates cumbersome castings and fragile mechanical devices; complete range of sizes from 3″ to 72″ made from any workable metal and with a wide choice of accessories.

Badger S-R Joints are probably the answer to your problem. There's an easy and quick way to find out — ask the Badgerman for his recommendations. Write or phone today. Badger Manufacturing Co., 230 Bent St., Cambridge, Mass.

© COPYRIGHT 1959 BADGER MFG. CO

BADGER S•R EXPANSION JOINTS

It takes unusual facilities to machine and cut a 22-ft. ring gear weighing 44,000 lbs.

The Farrel generator, on which this gear is being cut, is one of the largest in the world.

This giant, 7-degree, single-helical gear will be used in a cement kiln. Cast of alloy steel, the teeth were precision cut on a Farrel gear generator. Machining consisted of turning, boring, planing and drilling.

Having a 22-foot outside diameter and a face width of 19", it well illustrates Farrel's unique capacity for cutting gears of this type. The company's machining facilities are also unusually complete and fully able to handle any type of work on the largest gears required.

The maximum size of Farrel generated-tooth gears, single helical and spur, is 23 feet diameter, 30 inches face. However, by alternate cutting methods this diameter limit can be greatly exceeded. Continuous-tooth herringbone teeth can be generated up to 23 feet diameter and 60 inches face; also, internal gears can be produced with either single helical or spur teeth, in sizes up to 23 feet external blank diameter, 20 inches face.

Ask for details of large industrial gears to meet your requirements.

FARREL-BIRMINGHAM COMPANY, INC.
ANSONIA, CONNECTICUT

Plants: Ansonia and Derby, Conn., Buffalo and Rochester, N. Y.

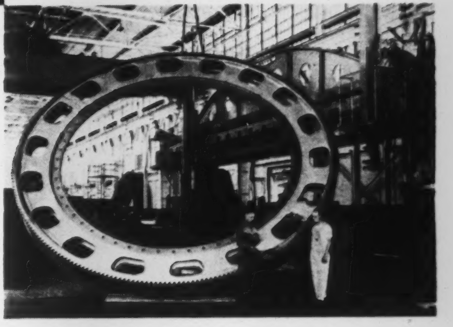
Sales Offices: Ansonia, Buffalo, Akron, Ann Arbor (Mich.), Chicago, Minneapolis, Los Angeles, Salt Lake City, Tulsa, Houston, Atlanta

European Office: Piazza della Republica 32, Milano, Italy

FB-1180

FARREL ®

Another view of the gear, behind which can be seen a Farrel-Betts 42-ft. vertical boring mill.



TRIPLE LANE TUBE LAYOUT . . .

what it is and how it IMPROVES CONDENSER OPERATING EFFICIENCY

An informative advertisement from one of the nation's most experienced condenser manufacturers

Steam condenser efficiency depends on water temperature and condition, proper maintenance procedures and many other factors. One of the most important is the design of the condenser itself—and *this* is largely a function of tube sheet design.

Triple Lane Tube Layout, a development of C.H. Wheeler Manufacturing Company of Philadelphia, is making significant contributions to condenser operating efficiencies in public utilities and industrial plants throughout the country. Figure 1 shows a C.H. Wheeler Dual Bank Surface Condenser with Triple Lane Tube Layout.

This tube sheet design permits steam to travel through three separate pathways. As a consequence steam penetrates to all condensing surfaces and utilizes to the fullest extent the condensing capabilities of the steam condenser.

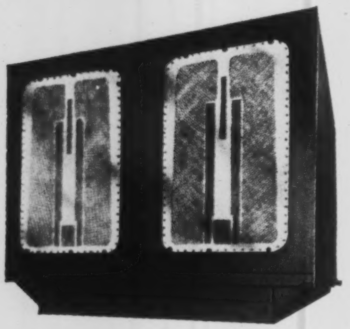


Figure 1: Typical C.H. Wheeler Condenser with Triple Lane Tube Layout.

Central location of the air cooler section, another C.H. Wheeler design feature, also improves steam travel. It reduces the depth of steam penetration and therefore reduces resistance to steam passage, achieving a new low in condenser pressure loss.

How Reverse Flow Improves Condenser Efficiency, Reduces Maintenance

Proper maintenance—keeping tubes and tube sheets free from foreign matter, algae and scale—helps keep condensers operating at peak efficiency. In some cases grass and twigs build up to a point where they would ordinarily have to be shoveled out! It is in such cases that C.H Wheeler Reverse Flow solves time-consuming, expensive maintenance problems. Here's how it works:

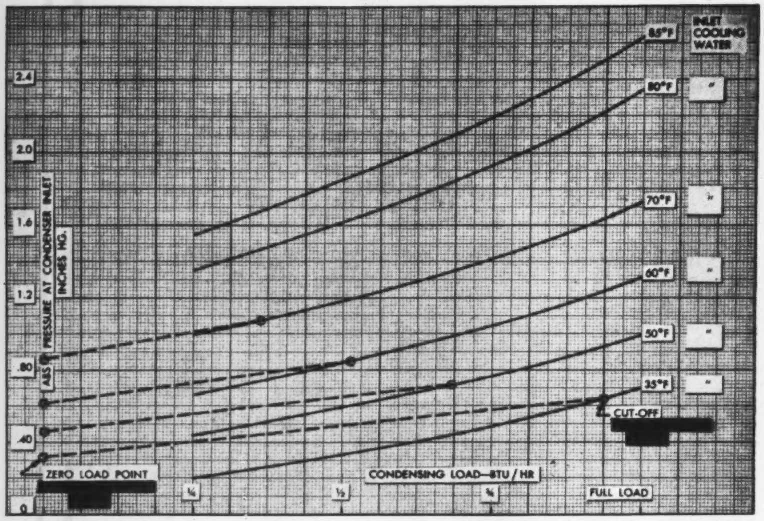


Figure 2: Typical condenser performance curves show how inlet cooling water temperature affects absolute pressure at condenser inlet at varying condensing loads. For a complimentary copy of the 38-page Condenser Handbook from which these curves are taken, write to C.H. Wheeler on your company letterhead.

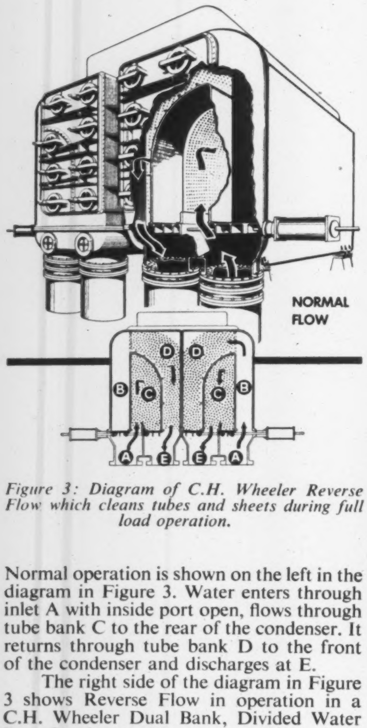


Figure 3: Diagram of C.H. Wheeler Reverse Flow which cleans tubes and sheets during full load operation.

Normal operation is shown on the left in the diagram in Figure 3. Water enters through inlet A with inside port open, flows through tube bank C to the rear of the condenser. It returns through tube bank D to the front of the condenser and discharges at E.

The right side of the diagram in Figure 3 shows Reverse Flow in operation in a C.H. Wheeler Dual Bank, Divided Water Box Condenser. Water enters through A with outside port open, flows up through channel B and through tube bank D to rear of condenser, returns through tube bank C to front of condenser and discharges at E.

Reversing can be accomplished during full load operation and full flow of circulating water, without additional pressure loss. Sluice gates for each half of the condenser move on a common stem. Each half of the condenser can be back-flushed independently; or both halves can be back-flushed simultaneously with one or two circulating pumps operating.

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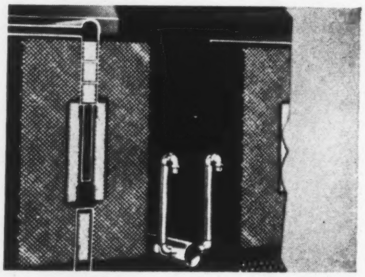

Figure 4: Central location of air cooler section in C.H. Wheeler Condensers reduces depth of steam penetration and therefore lessens resistance to steam passage, achieving a new low in pressure loss in the condenser.

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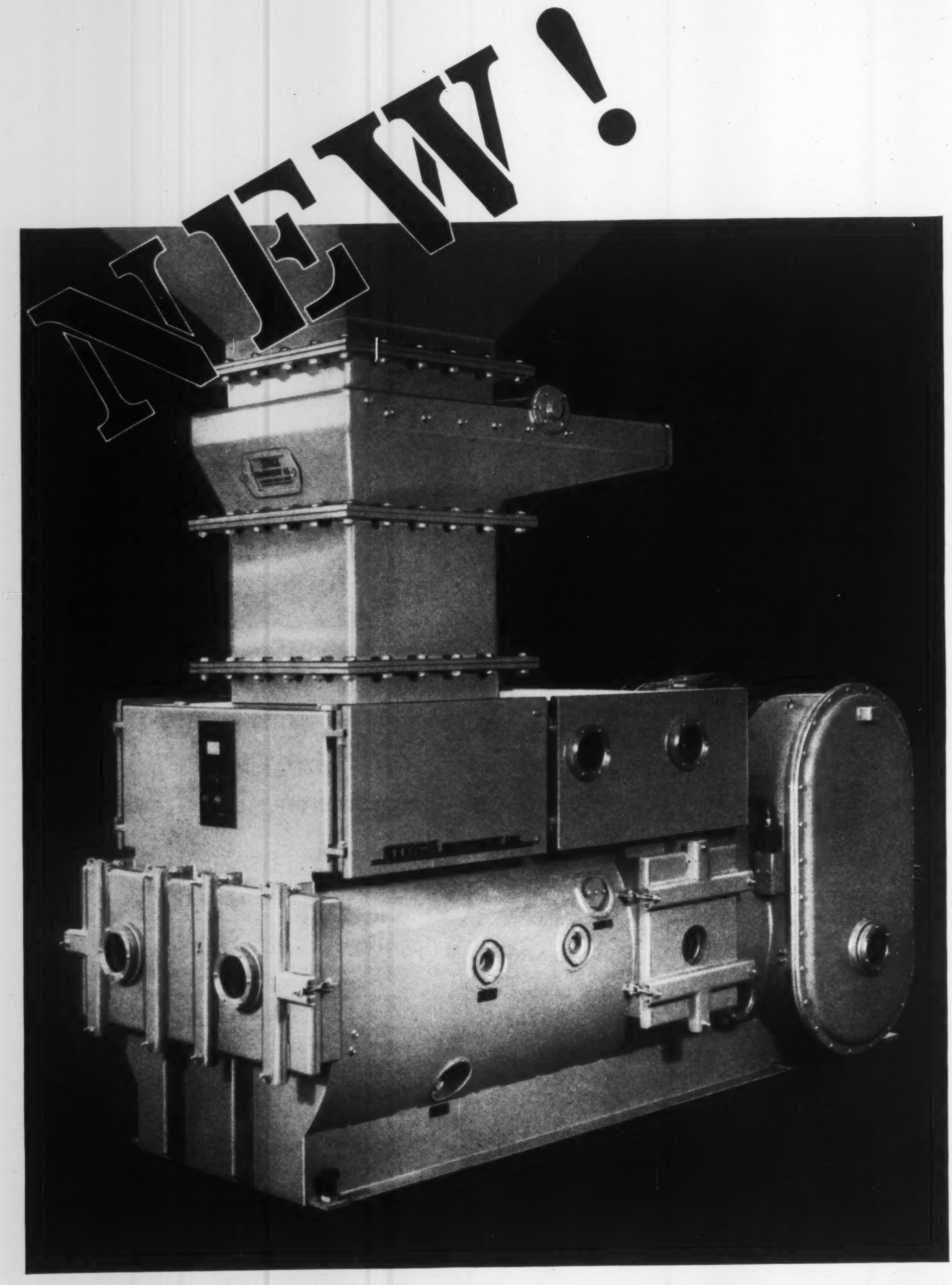
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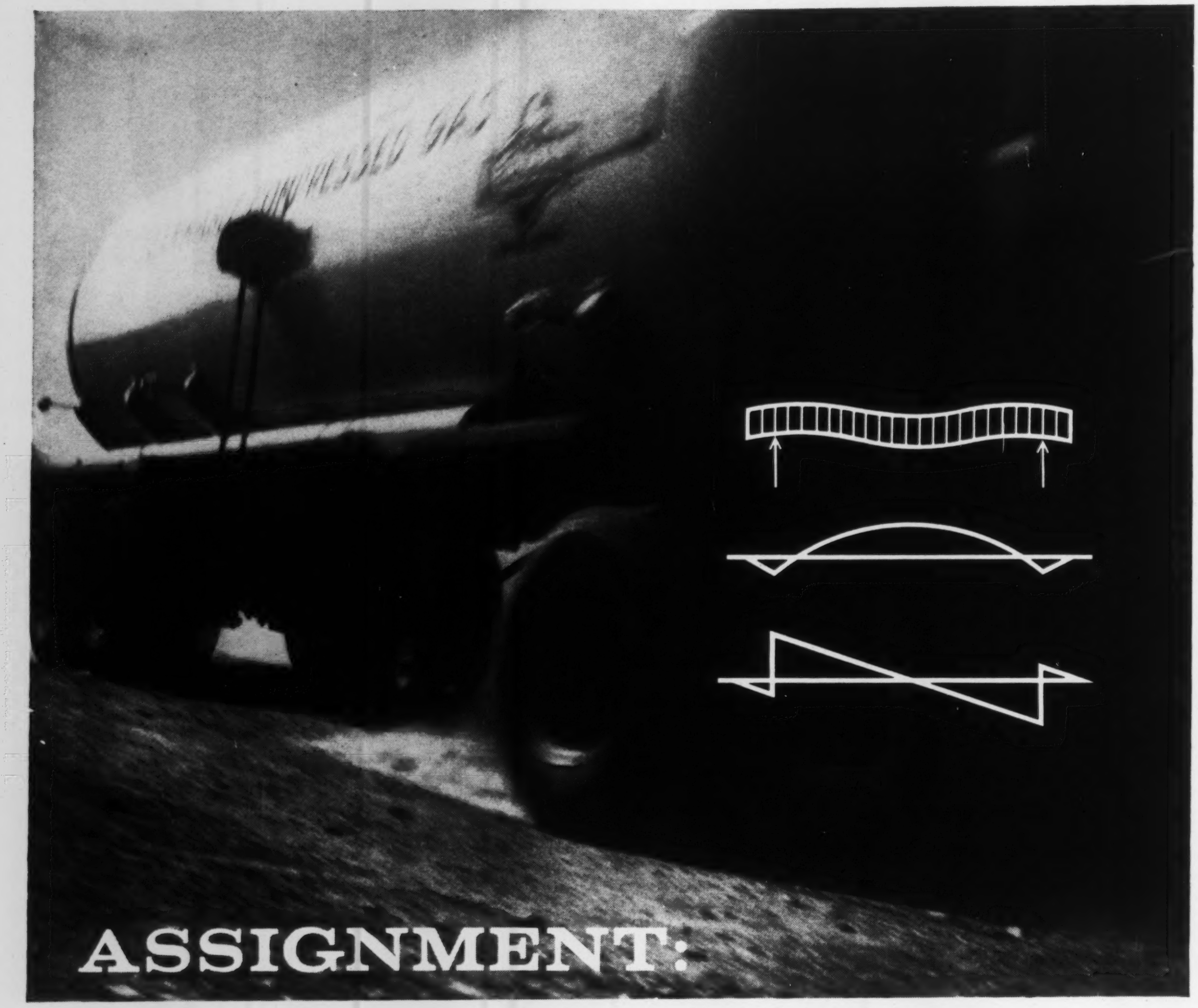

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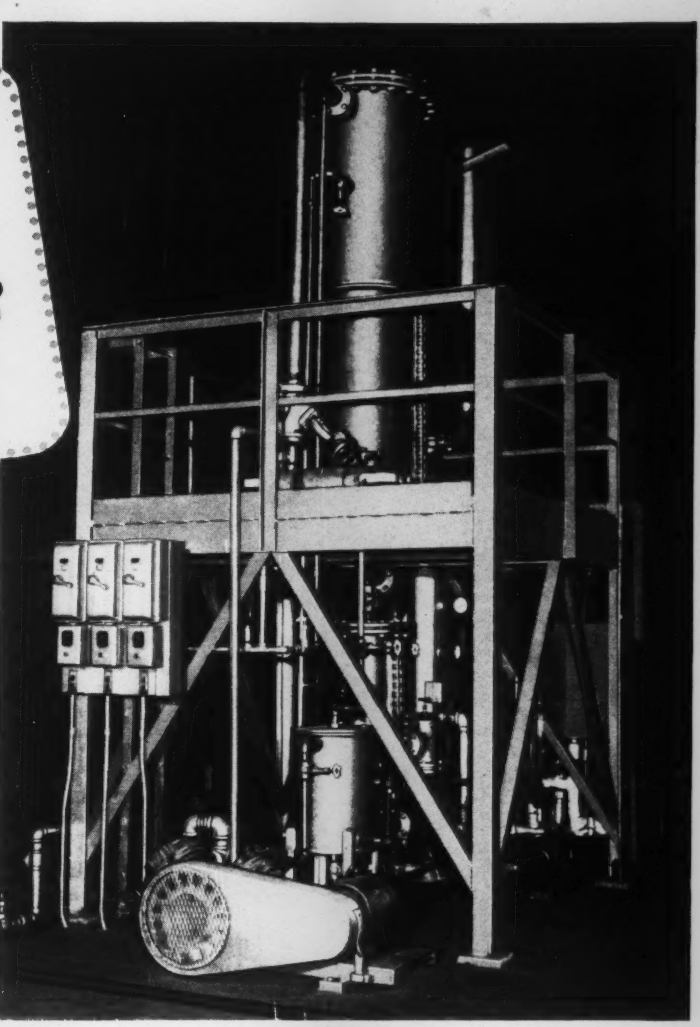

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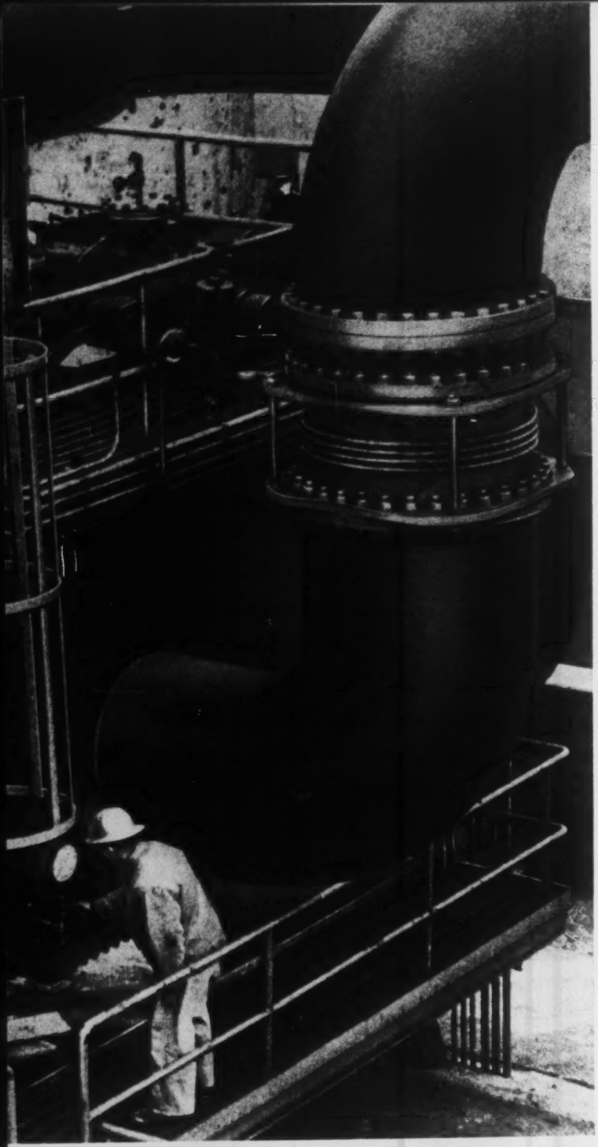

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USS "T-1" Steel Shaped like a giant seashell, a turbine scroll case must withstand tremendous pressure. Water gushes through the conch in an ever-tightening spiral before shooting into the blades. Chicago Bridge & Iron Company used USS "T-1" Constructional Alloy Steel for the shells of four of the largest scroll cases in the Noxon Rapids Dam in Montana. Because of the exceptional strength of "T-1" Steel—115,000 psi minimum tensile strength—the walls could be made nearly 50% thinner and 50% lighter than carbon steel walls. Freight costs were lower. And because there was considerably less weight, the foundations for the cases could be made lighter and less expensive.

USS MAN-TEN High-Strength Steel Manufacturers have turned to high-strength steels to increase the strength of earthmovers without adding to their weight. LeTourneau-Westinghouse Company built their Model B scraper with USS MAN-TEN Low-Alloy High-Strength Steel in the yoke structure, side sheets, body truss tubes, and apron arms. MAN-TEN steel has a yield point of 50,000 psi—about 50% higher than carbon steel. This extra strength also permits designs with thinner, lighter sections that can reduce weight as much as 1/3 with no loss of strength. And though MAN-TEN steel is exceptionally strong, it is not difficult to form. In fact, MAN-TEN steel frequently simplifies fabrication because it can be used in lighter gages.

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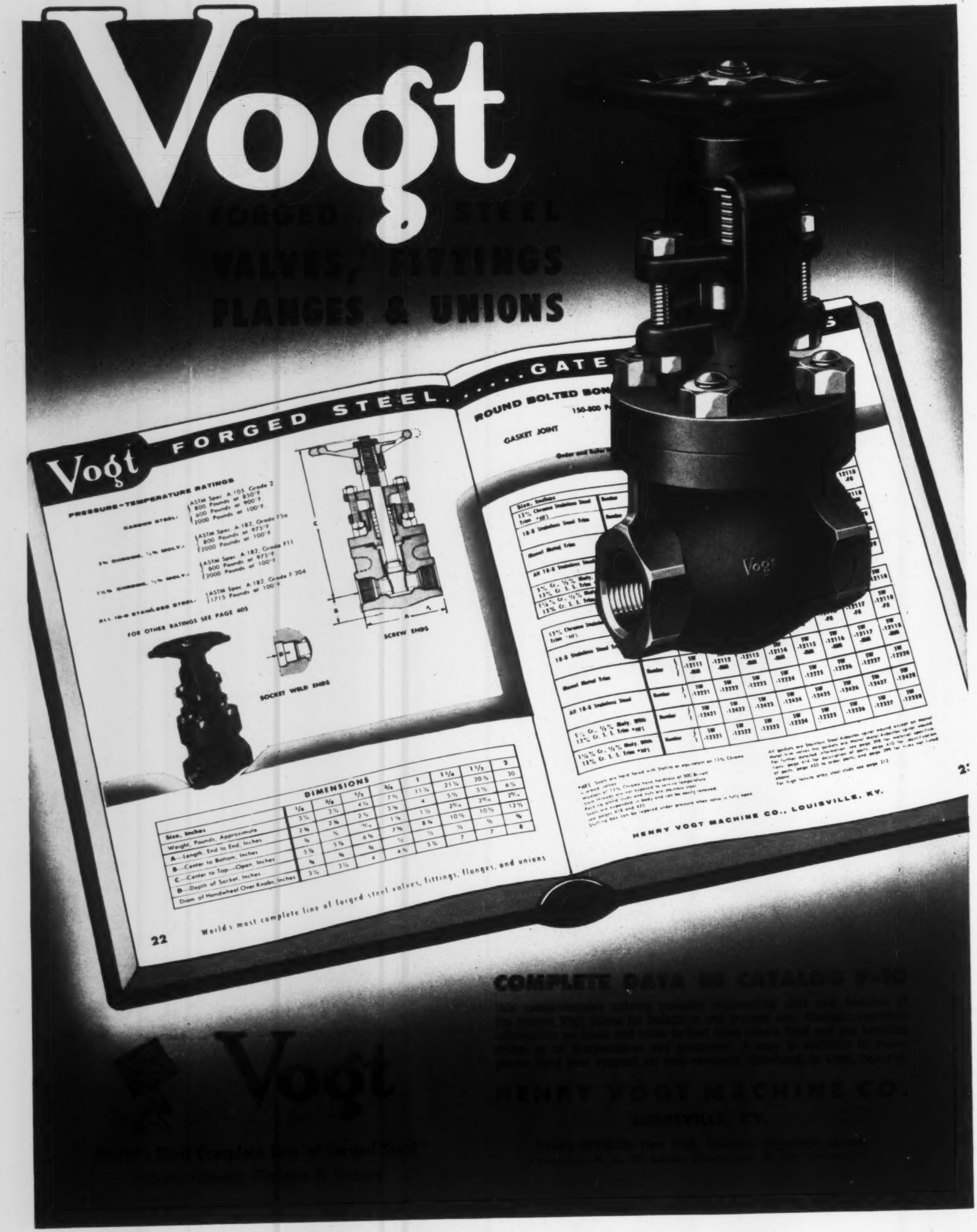
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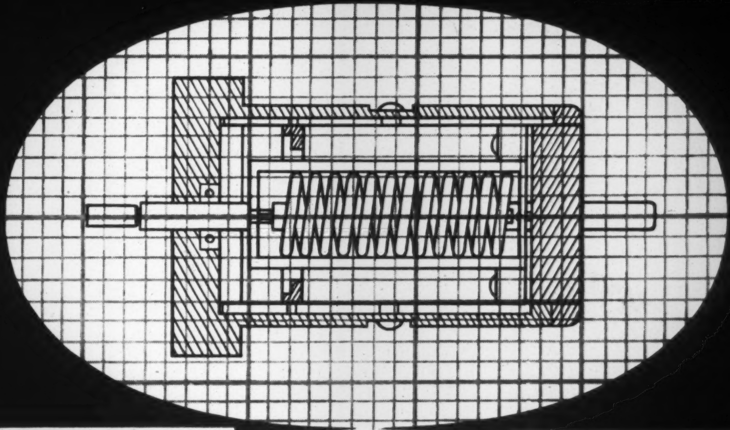

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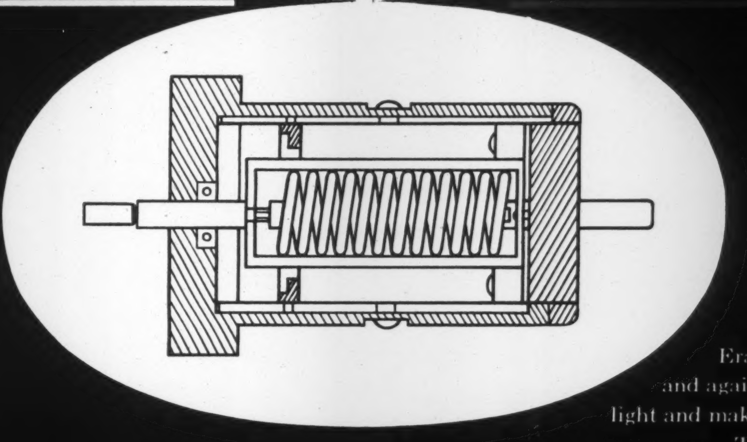

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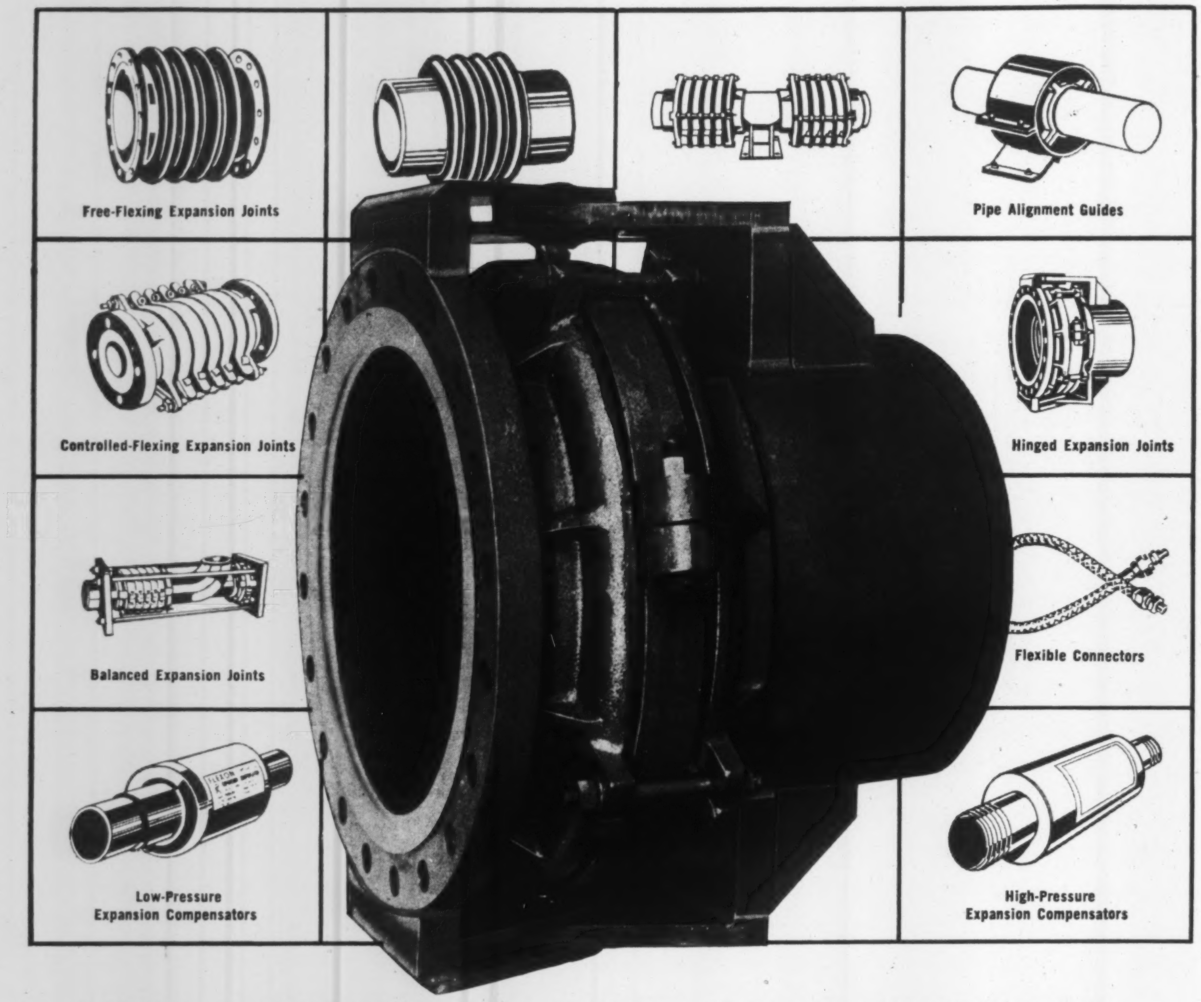
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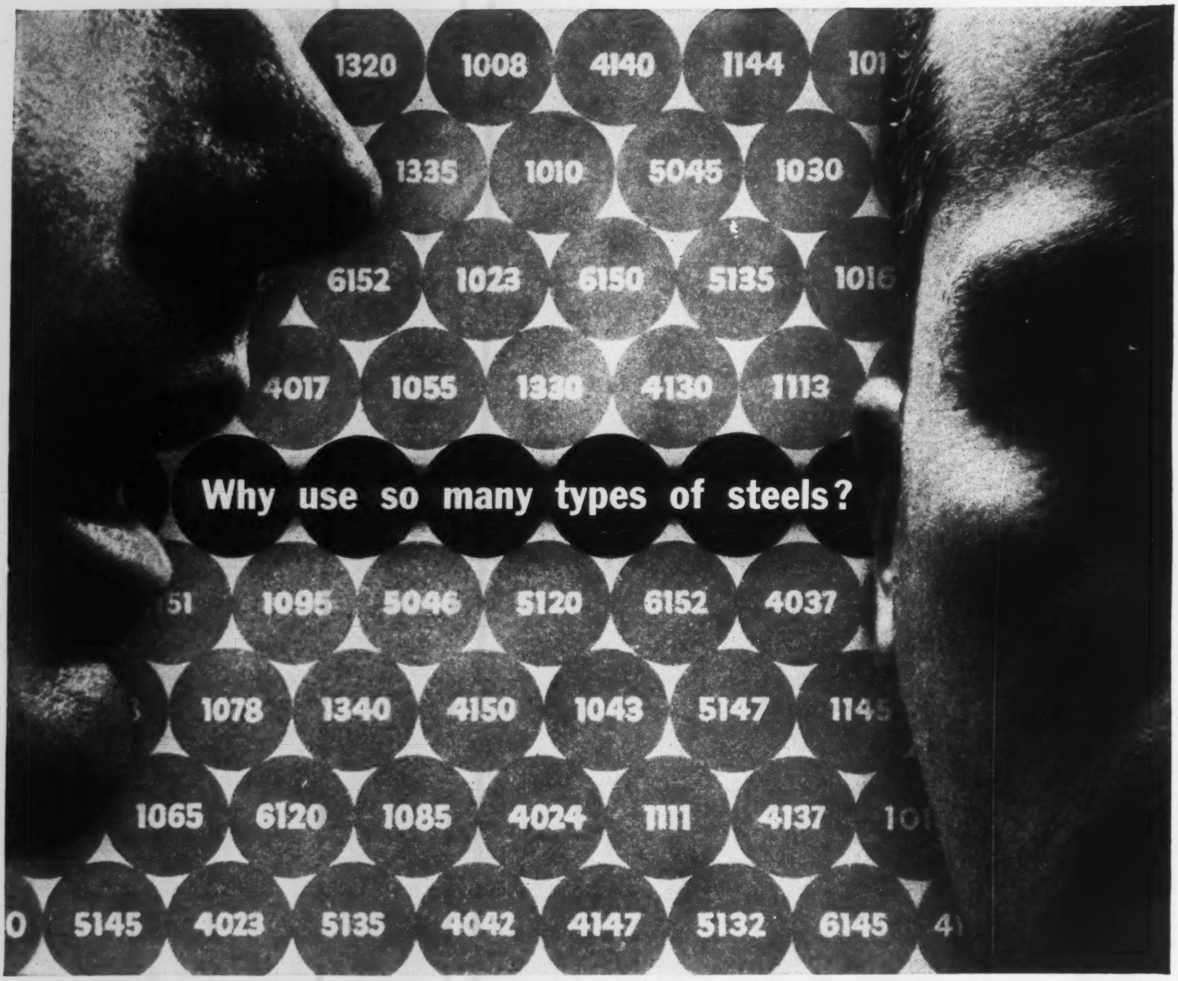
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MECHANICAL
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VOLUME 81 • NUMBER 11 • NOVEMBER, 1959

EJC Launches "Engineer"

The editorial in Mechanical Engineering for May, 1959, pointed up the need for an Engineers Joint Council publication—and advocated that such a publication be issued periodically and circulated to every one of the nearly 300,000 engineers in the 21 EJC societies. In urging publication of an EJC periodical, it was emphasized that, among other things, it could be a great step toward . . . . maintaining personal contact with engineers at the grass-roots level.

A step in this direction has been taken recently by EJC with the launching of *Engineer*, a periodical newsletter which will report on EJC activities, national affairs, and events which affect the engineer. Distribution will be free on request to members of EJC Societies.

In addition to reporting EJC's actions on behalf of engineering, the newsletter will cover national legislative, administrative, and legal events of importance to the engineer. *Engineer* will make available advance notices of EJC's periodic reports in such areas as manpower, engineering salaries, engineering college enrollment, military service for trained manpower, and international events.

Writing in the first issue of *Engineer*, September, 1959, Enoch R. Needles, EJC president, gives a succinct account of the aims, purposes, and hopes for this new venture. President Needles states: "This initial publication of *Engineer* paints another vivid mark of maturity on the steadily growing record of accomplishments through Engineers Joint Council. *Engineer* will be the means eventually of giving word to all engineers everywhere of the steady advancement of his profession. He will receive direct word of what EJC is doing on inter-Society matters; and more importantly, he will hear of the growing stature and activity of the engineer at the Washington level and in relation to the general public.

"*Engineer* will make it more clear than before that EJC is not and cannot be merely another Society designed to serve its individual members on a personal basis; EJC cannot be considered as a competitor of the fine Societies now established. EJC provides a meeting place for all the Societies to debate and act on common problems of importance, to the advantage of all. EJC is truly a Council, just as is the Engineers' Council for Professional Development. The strength of both lies in the fact that they are Councils of Society representatives, supplementing each other, and designed for specific purposes of common import.

"Those engineers delegated by their Societies to work most closely with EJC have long sensed the lack of means to portray adequately and effectively the story of joint Society activity which has been developing so notably in recent years. Both the criticism and the complaint have been heard with growing frequency and concern that the full story of EJC is known to only a relative few. The individual engineer throughout the country does not know and is not being told of EJC, the work this Council represents, and the many reasons given to us as engineers for having steadily growing pride in our profession."

News items in the first issue of *Engineer* appear under such diverse headings as: About EJC . . . . National Register of Engineers . . . . Research and Development . . . . Widening Horizons of Capitol Hill . . . . Notes on Education.

Although *Engineer* is not being circulated to 300,000 engineers, at least a modest start has been made in that a subscription to *Engineer* is available on request to members of societies belonging to EJC. This, of course, makes all ASME members eligible. So, to keep abreast of EJC activities, national affairs, and the Washington scene, it will prove worth while to write to Engineers Joint Council, 29 West 39th Street, New York 18, N. Y., and get a free subscription to *Engineer*.—*J. J. Jaklitsch, Jr.*

Editor, J. J. JAKLITSCH, JR.

"The only difference between a grave and a rut are the dimensions and the outlets."

A. A. Potter
Past-President ASME
Dean Emeritus
Purdue University

A CHALLENGE to ENGINEERING MANAGEMENT

Lifelong education is each man's personal problem. But management can open doors, make opportunities available.

By G. A. Hawkins,
Fellow ASME
Dean of Engineering
Purdue University
Lafayette, Ind.

The lifelong education of the professional engineer is the joint responsibility of engineering educators, of management, and of the individual professional engineer himself.

The four or five-year period the student spends in an engineering educational institution will be termed the introduction to professional engineering. Commencement is exactly what the word implies, the beginning of his professional engineering career which will cover a period of about 40 to 50 years—approximately ten times that of his formal university education. Yet, many regard commencement as the end rather than the beginning of their education.

If the professional engineer is to enhance his stature, he must accept learning as a continuous process, coextensive with the life span. Engineering teachers must share with the individual the major responsibility for the formal four or five-year program and graduate study. Thereafter, management must share with the engineer the responsibility for his uninterrupted intellectual growth.

Management must accept the challenge of the lifelong education of their engineers; first, by not expecting the universities to complete in four years what can only be accomplished in forty or fifty years, and second, by providing opportunities and encouragement for continued professional development and the acquisition of broad general knowledge.

The Pressure on Educators

It was concluded long ago that it would not be possible in four or five years to educate an engineering student who would satisfy all of the requirements of American industry. There are those companies which require that the graduate have a strong background in the fundamentals of mathematics, physics, and the engineering sciences; others desire students who have had extensive training in present-day practices. Add to this the effect of rapid scientific technological progress.

Even prior to 1940, important scientific developments began to place increasing demands upon the engineer's skill and knowledge. To cope with the new problems in electronics, the electrical engineer needed a deeper understanding of physics. A growing store of scientific information was required of the civil engineer in the study of structural problems as related to the welding processes, vibrations, and the unprecedented soil conditions encountered. Mechanical engineers were confronted with different problems in heat transfer, thermodynamics, and fluid mechanics as a result of the expansion of work in gas turbines and in rocket and jet propulsion, all of which required new methods of analysis and a better comprehension of physical phenomena. These developments, together with many, many others, were demanding an evolution within engineering education.

Some years ago, Dr. J. W. Barker, Past-President ASME, and a former Dean of Engineering at Columbia University, studied alumni opinions and reached a rather interesting conclusion. The opinions expressed by our former graduates may be said to follow, in general, the same pattern and may be grouped into four categories, each being associated with the number of years elapsed since graduation.

Based on a lecture presented to the Management Seminar, Product Development Laboratory, International Business Machines Corporation, Endicott, N. Y., April 16, 1959.

Four Phases of Graduate Life

During the period of from one to approximately five years after commencement, young men often feel that their programs of study should have included much more in the way of practical courses such as drafting, skill in programming, and so on. With a foundation of this type, they feel they could have started off immediately solving the day-by-day problems confronting them in industry.

The second group consists of those who have been out of college five to 15 years. These graduates feel that they should have had many more courses in mathematics, physics, chemistry, and the engineering sciences, as they need this type of information for solution of their difficult engineering problems.

The third group, having been out of school between 15 to 25 years, have become engaged in management and administration. In expressing their opinions, they feel that they should have been given many courses in organization, public speaking, labor relations, finance, life insurance, retirement programs, budgeting, stocks and bonds, and investments.

The fourth group consists of those who have been away from college for approximately 25 years or more. Those in this class who return appear very disappointed that few of their courses were devoted to the fine arts, music, literature, drama, and foreign cultures. These are the areas in which they feel deficient when talking to their contemporaries, and when traveling.

It would not be possible for an engineering student to acquire, in a four or five-year program, a knowledge of present-day practice, a strong foundation in the physical and engineering sciences, a broad education for management, and an appreciation for the arts, literature, and music.

Those engineering graduates who adopt a philosophy of lifelong learning during the course of their professional career, ultimately acquire this type of total education. We could cite many of our graduates who have never once stopped their learning experiences. I fear that many of those who complain have not chosen to regard learning as a lifelong process, and that they are not or have not been willing to put forth the necessary effort required by the adoption of such a philosophy.

The Engineering Curriculum

In the preliminary planning and design of engineering programs, curriculums should be designed with flexibility, so as to provide an educational background upon which different areas of interest can be based. For example, assume that we have two A-grade students, one interested in research, and the other in dealing with people. Should we force both through the same die? I think not.

There seems to be an impression that all of the poor students lean toward production, sales, and management. This is far from true; at least our 25,000 graduates of Purdue University in engineering do not follow any such simple pattern. The main problem we must face up to is that of providing programs for a variety of interests so that we can furnish industry with a broad spectrum of well-educated engineers capable of solving the problems of tomorrow.

Another factor is that, on the one hand, skilled technicians are taking over many tasks formerly carried out by engineers; on the other, the physicists, chemists, and mathematicians are assuming research and development functions in which engineers are also engaged. If engineering is to survive as a profession, we must develop in the engineer those unique aptitudes that enable him to play his essential role and which distinguish him from the pure scientist and from the technician. Many of us feel that this unique function of the engineer is design, and that this aspect should receive far greater emphasis in engineering curriculums.

In designing programs for engineering students, there are twelve elements which must be woven into the education fabric by way of courses, student meetings, faculty-student conferences, summer employment, and so on. These elements, discussed in detail in item 1 of the bibliography are: the learning process, appreciation of languages of engineering, understanding of natural laws and concepts, appreciation of engineering, general mode of analysis, laboratory experiences, knowledge of the properties of materials used by engineers, skill in mensuration and computation, knowledge of regulation and control, acquaintance with industrial processes, appreciation of values, and integration of subject matter for design.

As the student progresses he should be encouraged to look for ways and means of correlating and integrating fundamental knowledge. The more of this he can do, the stronger will be his foundation. For example, there are certain basic laws and relations which describe the flow of electricity in a circuit; many of the same equations apply to the flow of a fluid through a pipe, or the flow of heat through a building wall.

When, or if, we succeed in combining, in proper proportion and emphasis, the twelve basic elements herein proposed, then we shall have developed a curriculum for student engineers which will prepare them to face the unpredictable but almost certainly trying times ahead.

If we are successful, then at commencement time you should have available a young engineer who is challenged by the future, enthusiastic, well grounded in fundamentals, and a person having a desire to learn more.

Management's Responsibility

Management's responsibility toward the continued improvement of the engineer covers his entire professional life span. We have had four or five years to stimulate the student; management has approximately ten times that amount of time to contribute to his development. If management accepts the twelve basic elements, then postgraduate engineering education programs in industry should be designed to further expand certain of the elements.

It is the responsibility of the practicing engineer to teach the neophyte the special design procedures, manufacturing techniques, and the use of company-classified data. You well recognize that all problems in engineering are not solved by means of mathematical equations. In many instances an enormous amount of experience is required to determine the best solution.

In the comparatively short period we have to deal with the student, we make a concerted effort to instill in him a professional attitude. However, it is management's responsibility to fully develop this phase of the learning process. If you really believe that engineering is a profession, it is my opinion that more encouragement should be given your engineers to participate in professional-society activities, including publication of papers, attendance at local and national meetings, and participation in technical committee activities. They should be urged to become registered engineers.

One great responsibility of management in the lifelong education of the engineer is to see that ample opportunities are provided so that he may keep abreast of the latest scientific and technological advances throughout his career. This objective may be accomplished in many ways, some of which are:

1 Encourage the engineers to attend the technical meetings of their professional societies.

2 Provide library facilities in convenient locations.

3 Employ engineering teachers and consultants to brief the records in given fields for the engineers.

4 Seek the aid of engineering schools by having them offer special courses or programs.

5 Academic leaves for engineering personnel.

One hears the charge that some industries stifle the interest of engineering graduates by assigning them routine tasks. Some persons even contend that all phases of their early work should be of the challenging, creative type. This is not consistent with our way of life. Who has a job consisting entirely of creative work? It would be unrealistic to attempt to assign new graduates to creative work 100 per cent of the time. On the other hand, management should see that the work of the newly graduated engineer is properly balanced between what we might call routine and creative tasks.

The Engineer on the Team

Industry should be encouraged to recognize more fully and make greater use of the scientist-engineer-technical-skilled craftsman team; i.e., the scientist for basic research, the engineer for creative design and development, the technical man for the more routine and specialized tasks, and the skilled machinist for production setup, and so on.

Management should make thorough studies of positions held and the functions performed by their engineers after 5, 10, 15, and 25 years of service. Investigations of this type would yield significant information.

Efforts to learn the professional activities and duties of their graduates have been made by some of the engineering schools. One of these studies is entitled "Employment Histories of Engineering Graduates," by E. D. Howe (*Journal of Engineering Education*, vol. 37, no. 7, 1947). According to this report, the number of engineers in administration and management increases gradually from 9 per cent (6 to 10-year group) to 48 per cent (21 to 30-year group). The number in design diminishes consistently from 37 per cent (6 to 10-year group) to 20 per cent (21 to 30-year group).

What are the reasons for the increase in engineers entering the functions of administration and management in later years? Does this mean that there are more challenging positions in management than in design? Management should make a concerted effort to determine the opportunities available for engineers 5, 10, 15, and 25 years after graduation. What kind of positions exist, and how many of these are there?

If we are to encourage the student to develop an appreciation for the art of engineering, then our instructors must be familiar with professional practice in industry. In order to expand the knowledge of the faculty in this area, management must provide worth-while summer positions for young college teachers and employment during one-year leaves of absence.

The Engineer on His Own

The individual engineer, if he agrees with the 12 basic points in the design of the undergraduate program, should periodically evaluate his personal educational advancement in the light of these basic elements.

As his age advances, his outside interests may tend toward music, art, drama, and so forth. If he feels he would like to do oil painting as a hobby, and if the lifelong learning spirit has been properly instilled in him, he will take advantage of classes in the local art institute or may even enroll in a correspondence course in art. In so doing, he enhances the artistic qualities in his set of values.

One of the most important elements in the lifelong education of the engineer is the recognition by the individual that learning is self-discipline. Unless one has the desire to expand his knowledge, no amount of outside help will effect the end result.

The Schools Are the Beginning

The schools of engineering of this country have several major obligations—to the citizens who give so much financial support; to industries, large and small, which employ many of their graduates, support research programs, and provide scholarships; to the federal, state, and local units of government which support research and employ graduates, and, like industry, call upon members of engineering faculties for advice.

It is necessary to impart to all students, but to each according to his ability, the scientific and technical knowledge and experience needed to prepare them most effectively to meet their obligations to society. In order to accomplish this objective, it is necessary to supply, parallel with the professional education, a knowledge of man and his environment so that they may direct their professional work into useful channels and contribute to the success of living in peace with their fellowmen in this country and throughout the world.

Beyond this stage it is the primary responsibility of management to encourage the professional engineer to continually expand his educational background, and of the individual engineer to seek satisfying mental developments both within and beyond his professional field.

Bibliography

1 G. A. Hawkins, "Designing the Educational Program," *Journal of Engineering Education*, vol. 46, Nov., 1955.

2 L. M. K. Boelter, "Some Observations on Learning," *Journal of Engineering Education*, vol. 37, Jan., 1947.

3 L. M. K. Boelter, "The Design of an Undergraduate Engineering Curriculum," *Transactions of the Chemical Engineering Division of the American Society for Engineering Education*, 1950.

4 M. P. O'Brien, "The Nature of Engineering," *Journal of Engineering Education*, vol. 41, Nov., 1950.

5 L. M. K. Boelter and G. A. Hawkins, "General Mode of Analysis in Engineering Education," *Journal of Engineering Education*, vol. 44, Jan., 1954.

6 G. A. Hawkins, "Some Values for Engineers," *Purdue Engineer*, vol. 89, Feb., 1954.

7 W. E. Howland and G. A. Hawkins, "Graduate Program in Engineering," *Journal of Engineering Education*, vol. 44, no. 7, March, 1954.

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Engineering REDUCED-PLY Tires

Improvements in tire yarns and in tire-curing technology have reached the point where reduced-ply design is indicated. Taxi fleets are now testing 2-ply tires which run cooler and have a lower spring rate—and cost less.

The 4-ply passenger tire and the 12-ply truck tire have been industry standards that have remained relatively unchanged for many years in spite of the introduction of rayon and then nylon, although both are much stronger than cotton. During the past 10 years, 12-ply-rated nylon and rayon-cord truck tires with only 10 actual plies have gained acceptance, although there has been no change in the number of plies used for passenger tires. In the past year a widespread interest has developed in reducing the number of tire plies, prompted by recent developments in the technology used to build and cure tires reinforced with nylon.

A minor improvement in yarn can usually be capitalized on by reducing fabric end count 1 or 2 ends per in. and is easily dealt with. A major improvement, or a number of minor improvements collectively, may necessitate a change in yarn denier coupled with a change in cord construction, fabric end count, and possibly a change in the number of plies, and is a more complex situation. This is the case today with both rayon and nylon. The strength of nylon and rayon yarns has been increased to a point where, because of cord spacing, it is impossible to take full advantage of the yarns by simply reducing the end count.[1] There are two ways of handling the spacing problem. The easiest course for the tire company is to use a lower-denier yarn and increase the fabric end count and twist. Unfortunately, it costs more to produce light-denier yarns and, because of the higher yarn cost and increased cost of twisting, it is necessary to consider a second possibility—the use of heavier denier cords with a reduced number of tire plies.

Reducing the Number of Plies

The reduced-ply route appears to offer significant cost savings. The heavy-denier cords used can usually be built with lower cost, heavy-denier yarns. Fewer turns per inch twist are required to give the desired level of fatigue, so there is a cost savings in twisting. The fabrics woven from heavy-denier cords have fewer ends per inch, and fewer yards of fabric are required for reduced-ply tires. As a result of this, the weaving, dipping, and calendering costs per tire are less. Fewer plies also means lower labor cost in building the tire. The use of heavy-denier cords and fewer plies permits a substantial reduction in carcass thickness while maintaining optimum cord spacing, proper insulation, and equal carcass strength. There is also a substantial rubber savings, dependent on the number of plies removed.

Based on theoretical consideration, the optimum rayon and nylon cords for reduced-ply truck tires have been calculated.[2] Factors taken into consideration in-

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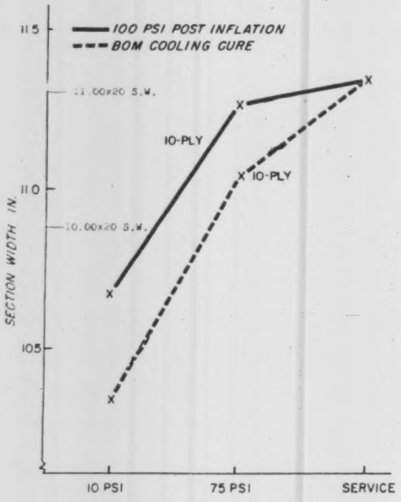
[1] Du Pont introduced the first high-tenacity tire yarn in 1934 having a strength level of about 3.0 grams per denier and the first super rayon in 1953 with a tenacity of about 4.5 grams per denier. In 1955, du Pont introduced type 272 "Super Cordura" high-tenacity rayon, the first of today's super-super rayons having a tenacity of over 5 grams per denier. Nylon tire yarn was introduced by du Pont in 1940 with a strength level of 6 grams per denier, 20 per cent stronger than the best rayon available today. Current nylon tire yarn has a strength level of over 9 grams per denier or 80 per cent stronger than today's best rayon tire yarn. Other properties of both nylon and rayon have been improved at a comparable rate to maintain a satisfactory over-all balance of properties.

Contributed by the Rubber and Plastics Division and presented at the Semi-Annual Meeting, St. Louis, Mo., June 14–18, 1959, of The American Society of Mechanical Engineers. Condensed from ASME Paper No. 59—SA-49.

[2] The constructions are based on a fabric strength of 8000 lb per in. To build 8-ply tires at this strength level, 33 ends per in. of 840/2 nylon would be required, and 25 ends per in. of 2200/2 super-2 rayon. The total nylon fabric thickness would be 294 mils as compared to 374 mils for the rayon-cord tire. For 6-ply tires, 22 ends per in. of 1680/2 nylon cord would be required, or 16.5 ends per in. of 4400/2 rayon cord. Fabric thickness would be 256 mils for nylon versus 348 mils for rayon. In the case of the 4-ply tires, 22 ends per in. of 1680/3 nylon cord or 12.5 ends per in. of 8800/2 rayon cord would be required, giving a total fabric thickness of 190 and 298 mils, respectively.

Engineering REDUCED-PLY Tires



Effect of postinflation on section width. The slope of the lines shows that there is a modest reduction in inflation growth and a major reduction in service growth.

clude commercially available yarns at present strength, denier, price levels, cost of converting, optimum cord spacing, and insulation between plies.

The strength advantage of nylon over rayon permits the building of reduced-ply tires using higher-end-count fabrics, and the resultant tires have a much thinner side wall. These are important factors affecting bruise resistance, flex fatigue, generation of heat in service, and softness of ride and cost.

Recognizing the possibility of a substantial improvement in cost-to-performance ratio in nylon-cord truck and passenger tires, a number of programs were initiated during the past 18 months to develop reduced-ply tires. It was obvious from the start that to take full advantage of nylon in reduced-ply truck tires, growth and tread cracking must be eliminated as the factors controlling the amount of nylon required for a given-sized tire.

It was found that postinflation as discussed by J. W. Bollmeyer, does a very satisfactory job on truck tires cured either in steam-dome or Bag-O-Matic type presses.[3]

Table 1 Reduced-Ply Nylon-Cord-Tire Performance 10.00 × 20 12-ply rating

	Controls		Nylon Test Tires		
	Rayon	Nylon			
Plies-breakers.......	10–2	10–2	8–0	6–2	4–2
Plunger, in-lb........	16,000	19,100	21,000	23,700	26,900
Spring rate, lb per/in.	4500	3800	3740	3720	3550
Step-load wheel test, miles to failure....	1350	2500	3485	2302	2540
Load, per cent of rated..............	130	150	170	140	150

Pressures in the range of 100 to 150 psi are required, and the quicker the tire is inflated after the press opens, the better the results.

The effect of postinflation on section-width growth of 10-ply nylon-cord tires cured in a 10.00 × 20 rayon-cord tire mold is a modest reduction in inflation growth and a major reduction in service growth. Of major importance is the fact that by using postinflation, based on tire and rim specifications, an 11.00 × 20 nylon-cord tire can be cured in a 10.00 × 20 rayon mold, with minor adjustments to allow for extra rubber.

A number of 10 and 12-ply nylon-cord 10.00 × 20 tires were made from 840/2 cord fabric at 32 ends per in. One half of the 10-ply tires were postinflated at 100 psi. A high-mileage fleet test of 12 of each of the three types of tires showed that both 10 and 12-ply nonpostinflated tires suffered excessive cracking during the first 14,000 miles of service. In sharp contrast, tread cracking was eliminated in the postinflated 10-ply tires. These also gave about 16 per cent better tread wear than the nonpostinflated tires with 12 full plies.[4] Both improvements are believed to have resulted from the significant reduction in service growth to about 1 per cent for the postinflated tires.

Reduced-Ply Truck Tires

Having established a means of producing low-growth nylon-cord tires, studies were initiated involving heavy-denier cords in 4, 6, and 8-ply nylon-cord tires rated as 12 ply. The 8, 6, and 4-ply tires were made from cords containing 2, 3, and 4 ends of 1680-denier nylon yarn. The relative-strength level of the nylon-cord tires ranged from 95 to 100, as compared to 80 for the rayon control made from super-super rayon. Nylon-cord-tire weights ranged from 113 lb for the 10-ply tire down to 95 lb for the 4-ply tire, compared to 118 lb for the rayon control. The 10-ply nylon-cord tire cost about $4.20 more to build and cure than the rayon-cord tire, while the 8, 6, and 4-ply nylon-cord tires cost from $3.20 to $9.40 less to build than the rayon-cord tire.

In laboratory performance, Table 1, even though the reduced-ply tires contained 3 to 5 per cent less nylon than the 10-ply nylon control, they gave a 20 to 40 per cent higher plunger value. The spring rate, that is, the force in pounds required to deflect an inflated tire 1 in., ranged from a high of 3800 lb for the 10-ply nylon control to 3550 lb for the 4-ply nylon-cord tire, versus 4500 for the rayon control. This accounts for the softer

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[3] James W. Bollmeyer, "Preparation and Processing of Nylon Tire Cord," ASME Paper No. 59—SA-50. The author states: "Described simply, this technique involves removing the cured nylon-cord tire from the automatic curing press, and while still hot, immediately mounting the hot tire on a wheel and inflating the tire with air to a certain pressure—usually 50 to 75 psi for passenger tires and 100 to 150 psi for truck tires. The tire remains inflated for a period about equivalent to the curing cycle—about 20 to 25 min for a passenger tire. Broadly speaking, this technique results in the following benefits:" (*a*) Postinflation eliminates the need to cool nylon tires in the mold, shortening the curing cycle and increasing curing capacity; (*b*) a tire inflated while still hot and kept inflated while being cooled will stabilize in an expanded condition, thus increasing the initial tire size and permitting the use of smaller molds; (*c*) postinflation eliminates the tendency of improperly cooled nylon tires to shrink more under the tread area and thus produce a concave tread; (*d*) tread cracking from excessive inflation and service growth is reduced, allowing a higher-modulus stock to be used in tread compounding to improve tread wear.

[4] In the step-load test to determine durability, rayon-cord tires failed on the average at 1350 miles at 130 per cent overload. The 12-ply nylon-cord tires which were not postinflated failed with an overload of 150 per cent at an average of 2420 miles. The 10-ply, postinflated nylon-cord tires were equal to the 12-ply control, failing at 150 per cent load and 2485 miles—even though they contained 17 per cent less nylon.

Table 2 2-Ply Nylon-Cord Tires 7.50 × 14

	Controls		Nylon	
	Super-2 rayon	Nylon	2-Ply Tires	
Cord	1100/2	840/2	1680/2	1680/2
Ends per in. calendered	32	29	25	25
Plies-breakers	4–0	4–0	2–1	2–0
Relative strength, per cent	76	100	102	88
Cost differential, c	Base	+15	−60	−90
Tire weight, lb	22.7	20.9	19.1	18.7

Table 3 2-Ply Nylon-Cord Tires 7.50 × 14

	Controls		2-Ply tires	
	1100/2 Rayon	840/2 Nylon	1680/2	1680/2
Plies-breakers, number	4–0	4–0	2–1	2–0
Plunger, in-lb	7200	15,000	13,300	10,200
Crown-impact endurance (M impacts)	160	500	310	60
Failure	X break	Tr. sep.	Tr. sep.	Tr. sep.
High speed, mph	90	100	100	100
Tire temp, deg F @ 80 mph	242	233	220	208
Spring rate	1080	950	930	900

ride of nylon-cord tires. Again, on the step-load wheel test, the reduced-ply nylon-cord tires gave equal or better performance than the 10-ply nylon controls and far superior performance over the 10-ply rayon controls made with super-super yarns. The nylon-cord-tire failures occurred at mileages in excess of 2300 and at overloads ranging from 140 to 170 per cent, whereas all rayon-cord tires failed at less than 2000 miles with load ratings of 130 per cent or less. At the present time several hundred 4, 6, and 8-ply, 12-ply-rated nylon-cord tires are on fleet tests. Many have completed the original tread and are running either on the first or second recap. Preliminary results from the fleet are most encouraging.

Reduced-Ply Passenger Tires

In addition to the work under way on reduced-ply nylon-cord truck tires, there are a number of programs in progress involving 2-ply nylon-cord passenger tires. To alleviate the possibility of developing misleading information, all tires for du Pont testing are built using optimum trade-accepted practices relative to cord processing, tire building, and curing. All control tires are regular production items.

The most encouraging 2-ply nylon-cord-tire results are being obtained with 1680/2 cords at 25 ends per in. in the calendered fabric. In Table 2, 2-ply tires with and without breakers are compared with typical nylon and super-super rayon 1100/2 controls. The 4-ply rayon and nylon-cord control tires were made from green fabric having 32 and 29 ends per in. Fabric made of 1680/2 cords at 25 ends per in. was used for the 2-ply tires. The rayon-cord tires had a calculated crown strength 76 per cent of that for the 4-ply nylon control. The 2-ply tire with one breaker cut from 840/2 fabric with 19 ends per in. was equal in strength to the control, and the 2-ply tire with no breaker had a strength calculated to be 88 per cent of the 4-ply nylon control. An economic analysis of the four tires shows that on a factory-cost basis the 4-ply nylon-cord tire cost 15 cents more than the rayon; whereas, the 2-ply nylon-cord tires were 60 and 90 cents cheaper to build than the rayon-cord tires. The 2-ply tires each weighed about 2 lb less than the 4-ply nylon control.

Durabilitywise, the 2 and 4-ply nylon cord tires showed a substantial advantage over the 4-ply rayon cord tires, Table 3. The nylon-cord test tires gave plunger values ranging from 10,200 to 13,300 in-lb as compared to 7200 for the rayon control. On the crown-impact endurance test, the rayon controls average 160-M impacts to failure, and all failed due to blowouts. The nylon-cord tires, however, failed due to tread separation after 500 M, 310 M, and 60-M impacts, respectively, for the nylon control, the 2-ply tire with breaker, and the 2-ply tire without breaker. The nylon-cord tires suffered no loss of air or damage to the carcass. On the high-speed wheel, where all tires fail due to tread-chunking, the nylon-cord tires ran the usual 10-mph higher speed before failing than the rayon controls. At 80 mph the 2-ply tires ran 22 to 34 F cooler than the rayon-cord control tires. As in the case of reduced-ply truck tires, the nylon-cord tires have a significantly lower spring rate than the rayon control. The nylon-cord-tire spring rate ranged from 950 for the 4-ply control down to 900 for the 2-ply tire without breakers, as compared to 1080 for the rayon control. A low spring rate is a decided advantage, as it results in a softer, more comfortable ride.

Improving Tread Wear

Recognizing that 2-ply tires have a lower spring rate than 4-ply tires, which might adversely affect treadwear, studies were initiated to improve the treadwear of nylon-cord tires. The use of SAF[5] black and improved techniques for dispersing the carbon black in the tread rubber compounds gave an average 38 per cent improvement in three separate laboratory studies.

In laboratory and fleet tests, the control tires gave an average of 68 miles per mil of tread, experienced no tread cracking, and ran the full 3000 miles on the high-speed endurance test regardless of whether they were postinflated or not. The nonpostinflated tires with an experimental tread compounded with SAF black suffered excessive tread cracking on the fleet test and failed at 1255 miles due to tread-chunking on the high-speed endurance test. Postinflation of the tires with the improved tread compound eliminated the tread-cracking problem. These tires gave 94 miles per mil and ran the full 3000 miles on the high-speed endurance test.

At the present time there are some 300 2-ply passenger tires with standard tread compounds on taxi fleets to test tire durability, treadwear characteristics, and driver acceptance. Reduced-ply truck tires and 2-ply passenger tires with improved tread compounding are being made on a commercial basis for fleet testing.

There is a high level of interest in developing reduced-ply truck and passenger tires, and many programs are well under way. Postinflation has eliminated the need for overbuilding nylon-cord tires to control growth. Economic studies favor the heavy-denier-cord and reduced-ply route to lower-cost tires. Extensive laboratory testing and limited fleet testing have revealed no major problems in the performance of reduced-ply, nylon-cord tires. A lead to improved treadwear has been demonstrated on a laboratory basis, and field testing of reduced-ply truck and passenger tires is under way at a number of locations throughout the country.

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[5] SAF = superabrasion furnace.

POWER IN SPACE

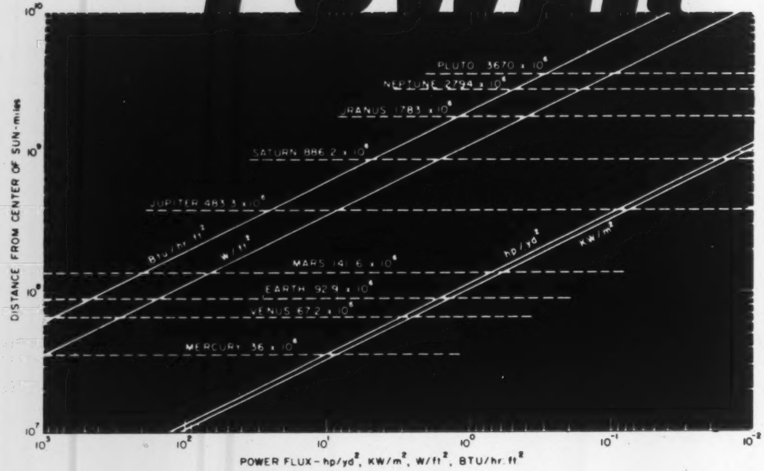

Fig. 1 Solar energy. Power flux is shown as a function of distance from the sun.

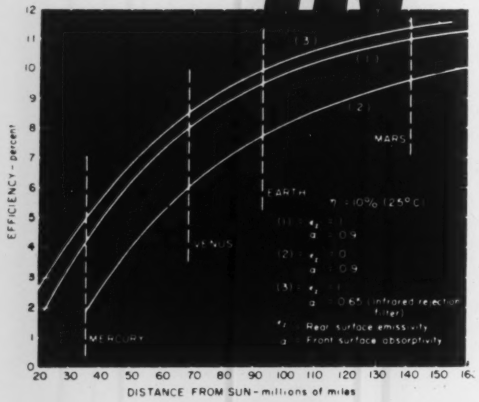

Fig. 2 Presenting solar-cell efficiency as a function of distance from the sun for several values of surface emissivity and absorptivity

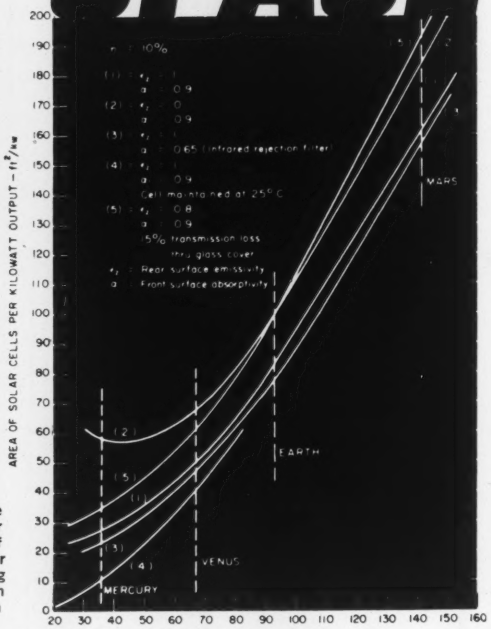

Fig. 3 The required area per kilowatt output of silicon solar cells at varying distances from the sun

Before man can explore the planetary system,
engineers must provide the rockets with auxiliary power for instrumentation,
stabilization, environmental control,
and—most demanding of all—communication.

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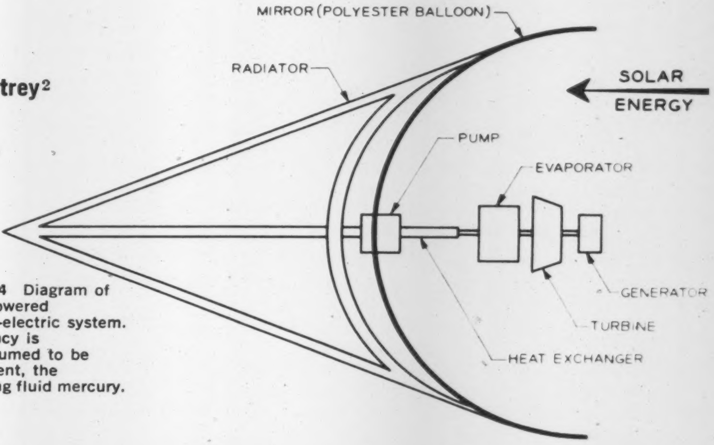

Fig. 4 Diagram of a solar-powered turbo-electric system. Efficiency is assumed to be 30 per cent, the working fluid mercury.

PROBABLE SOLUTION: A SOLAR POWER PLANT

Auxiliary power requirements for exploratory vehicles operating in space are severe, if communication is required throughout mission lifetime.

For most anticipated missions, power demands for communication are dominant over other functional requirements such as instrumentation, stabilization, and environmental control. Progressive steps in Mars exploration might take the form of:

1 A "minimum" space probe wherein a limited amount of instrumentation is contained in the vehicle and communication is maintained in one direction only at a low rate, requiring transmitter powers of roughly 10 kw for about 40 days.

2 A "maximum" space probe; i.e., a completely instrumented vehicle capable of two-way continuous communication with transmission of visible information from the vehicle to an earth station, requiring up to 500 kw for mission lives of about 400 days.

3 A manned mission with consequent increased power needs for instrumentation and environmental control, but perhaps needing only one-way communication due to the presence of a crew, and requiring 200 to 500 kw with life of roughly 900 days for a round trip plus a full exploratory effort.

Nuclear, solar, and chemical-energy sources superficially appear usable for the Mars mission. Elementary analysis can establish that a system relying solely upon chemical energy is impractical. However, chemical systems may still play a significant part in the final solution since no better methods have been devised for energy storage in cyclic systems with variable energy supply or consumption. In general, weight and reliability are underlying problems for all space equipment.

Solar Energy

A power system employing solar radiation as a prime energy source is basically desirable to eliminate the lo-

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[1] Manager.

[2] Staff Engineer.

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gistic problem of conveying energy in stored form. A number of difficulties are inherent, however, in actually applying solar energy:

A need for large collectors or solar concentrators as a result of low solar flux densities providing approximately 1400 watts per sq meter at the earth's distance from the sun and about 600 watts per sq meter in the orbit of Mars.

A need for continual orientation of large structures.

A possible need for energy storage.

System inefficiency resulting from the characteristics of auxiliary equipment required for conversion of solar energy to a more usable form.

Among the means which may be used for conversion of concentrated or unconcentrated solar energy into electrical energy are: photovoltaic cells; closed turbine cycles; thermoelectric converters; thermionic devices; photochemical devices. Currently, the first two appear to be the most likely for immediate applications in space. These two systems will illustrate the primary problems associated with most other systems which might be considered.

The size and weight of systems depending upon solar energy are directly influenced by the solar flux density, shown in Fig. 1 as a function of distance from the sun and in several sets of units.

The Photovoltaic Cell

The problem of high equilibrium temperature is natural to any power system employing solar energy, and is especially important in the case of a power supply relying on the solar cell since cell efficiency decreases as temperature increases.

Design curves have been drawn[3] presenting the equilibrium temperature of silicon photovoltaic solar cells as a function of distance from the sun, with absorptivity and emissivity on both sides of the solar cell as the curve parameters, and assuming 10 per cent efficient solar cells at room temperature which represents current commerical availability. An approximate relationship between equilibrium temperature and solar-cell efficiency has been charted, using normal room-temperature cell efficiency as the curve parameter. Fig. 2 summarizes these data.

It is shown that an increase in efficiency from 10 to about 12 per cent is obtained in traveling from an Earth-to-Mars orbit. These curves include the effect of reduced equilibrium temperature due to the withdrawal of electrical energy.

To determine the required weight of silicon-cell material per kilowatt at any given location in the solar system, it is necessary to introduce solar-cell efficiency into the calculation as a function of location in the solar system. Fig. 3 constitutes a set of design curves for five possible operating conditions. Curve 3 represents the potential improvement in efficiency which can be obtained by filtering out all solar radiation having wave length greater than 1.1 micron. Such radiation contributes to increased equilibrium temperature of the silicon cell and thus reduces its efficiency. Because of the silicon-cell operating characteristics, however, solar radiation with wave length above 1.1 micron does not contribute to the usable electrical energy of the system. Thus some method of filtering and heat rejection would prove desirable.

Curve 4 shows the value of cooling the cell at distances close to the sun. The refrigeration unit, of course, must be light enough to take advantage of the increased cell efficiency. Curve 5 indicates the increased weight required when a glass cover is used for protection from micrometeorite abrasion.

Anticipated improvements in solar-cell efficiency and weight are to be expected in the reasonably near future, providing not only an improved solar-cell efficiency but also a more advanced structural factor; i.e., a reduction in the ratio of total power-supply weight to solar-cell weight.

When the power rating of a system reaches the magnitude of several kilowatts, a photovoltaic structure is required having an area of tens or hundreds of square meters of solar cells positioned normal to the solar-radiation vector. No experience with the reliability and operational characteristics of large structures is presently available.

Solar Turboelectric System

The solar-powered turboelectric system is illustrated diagrammatically in Fig. 4. For this brief presentation, the system is assumed to have an over-all efficiency of 30 per cent. A high-temperature system is desirable (temperatures of 3000 C or higher are readily obtainable by means of crude solar concentrators), and mercury is selected as a suitable working fluid. In addition, the problem of heat rejection in space dictates the highest permissible operating temperature.

For operating in the solar orbit of the earth, the system weight is 200 lb per kw for a 1-kw system. The weight is reduced to approximately 10 lb per kw for a 100-kw system and 7.3 lb per kw for a 1000-kw system. Thus the weight advantages of the solar-operated turboelectric system are not realized in the lower capacity systems but become highly significant for large systems.

To demonstrate the effect of varying solar flux density on weight of the turboelectric system, calculations were made for two specific systems—100 kw and 1000 kw—as a function of distance from the sun. With fixed generation-unit weights, both systems showed over-all-weight sun-distance curves which took a pronounced bend at a point 4×10^8 miles from the sun, calling for rapidly increasing collector weights. This is a point near the orbit of Mars.

Thus the orbit of Mars is located at an interesting distance from the sun with respect to utilizing solar radiation as a prime-energy source. At points closer to the sun, fixed weight in the power supply has a tendency to dominate system design. At points further removed from the sun, reduction in solar radiation density makes necessary the use of enormous collectors. The weight of the collector then becomes the most important single factor in system design.

Collector weight was almost negligible for either system in the solar orbit of Mercury where the lb per kw weight of the 100-kw system is 9 lb. On the other hand, either system is dominated by collector weight in the solar orbit of Uranus where a weight of approximately 670 lb per kw is required for both systems.

Nuclear Systems

Possible nuclear systems include:

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[3] The original paper, No. 59—Av-18, which contains diagrams, calculations, and text omitted here, may be obtained through the ASME Order Department, 29 West 39 Street, New York 18, N. Y.

Fission reactor used in thermal conversion cycles with turbines, thermocouples, or thermionic emitters.

Radioisotope energy sources, used in thermal conversion cycles with turbines, or in direct-conversion devices involving the collection of charged particles emanating from the natural radioactive material to the anode, taking advantage of space vacuum conditions.

Other systems, such as the radiolysis of water to provide hydrogen and oxygen to a fuel cell in a closed cycle.

Nuclear-system development, of course, is confronted with the well-known problems of minimizing system weight, obtaining high reliability, and expelling large amounts of excess heat in large radiator structures exposed to meteoroid bombardment. Weight problems are associated with the source, control systems, conversion equipment, radiator for emitting excess heat, and any shielding required to protect equipment and inhabitants. With today's techniques, isotope-fueled systems present weight advantages only for short-time missions.

For relatively low power requirements, the reactor weight dominates the radiator and other component weight, while for high power requirements the reverse is true.

At present state-of-the-art temperature levels, power plants utilizing static or dynamic heat engines can be developed having specific weights less than 10 lb per kw for electrical power levels over 200 kw. Development of reactor heat sources operating at higher temperatures on the order of 1700 to 2000 F, combined with the development of single-loop systems using new working fluids such as rubidium and other exotics, should lower this to about 6 or 7 lb per kw; i.e., we can probably get this within 10 years. Comparable gains may lower radiator weights from current estimates of 1 to 2 lb per sq ft down to $^1/_4$ or $^1/_2$ lb per sq ft.

Radiation of unused thermal energy presents serious limitations in system design. In many cases, the radiator weight is comparable to all the rest of the system. The radiator temperature should, in general, be low to promote efficiency of the system, and conversely, it should be high to decrease the area and weight required.

Reactor life is presently determined by complex interlocking mechanisms of fuel burn-up, poisoning, gassing, materials corrosion, and other factors which presently limit long-life operation to relatively low temperatures on the order of 1300 to 1500 F for operating periods of probably less than one year. Fuel burn-ups are presently less than about $^1/_2$ per cent. If a reactor is developed for minimum weight, many of the materials which make this development possible also offer serious gassing problems. It is expected that developments by the time of the first manned Mars mission will produce reactors operating at perhaps 1800 to 2000 F reliably over a period of 3 or 4 years with fuel burn-ups exceeding 1 or 2 per cent.

Shielding

At present, proposed reactor schemes have shielding weights on the order of 10 to 25 per cent of the rest of the system for just electronic shielding and close to 100 per cent of the rest of the system for biological shielding. Hazards are quite a serious problem when using radioisotope supplies, because of the danger of launching-pad aborts or explosions of some type. Thus the container must be able to contain the isotopes within a given area at launch. If the missile should inadvertently enter the earth's atmosphere at a nondesignated spot, the isotope itself must be of such a form that it will not readily dissolve in water or contaminate the atmosphere. The same problem is prevalent in reactors. After a reactor runs for a number of years, it is quite radioactive and, if the space probe is to come back to earth, there must be some way to insure that the reactor will not become a hazard if accidents occur. This can be done by atomizing the reactor far out in space or building a heavy and strong container about it. Neither proposition looks very attractive.

Heat Rejection

Energy can be rejected from a system in space (without the loss of mass) only by radiation. Owing to the inefficiency of conversion equipment, about 90 per cent of the total original energy will generally appear in the space-vehicle system in the form of low thermal potential waste heat. Thus 90 per cent of the total energy supplied must be rejected by thermal radiation.

Problems in the development of suitable radiators for space application include:

Optimum weight design.

High-temperature operation with corresponding material problems.

Compatibility between heat-transfer fluids and radiator materials at high temperatures.

The loss of heat-transfer fluids by gaseous diffusion and leakage.

The probability of damage by meteorite bombardment.

Fabrication problems associated with the need for an extremely large lightweight, hermetically sealed structure which must either be assembled in space or be able to sustain accelerations necessary to place it in an orbit or trajectory.

Meteoroids

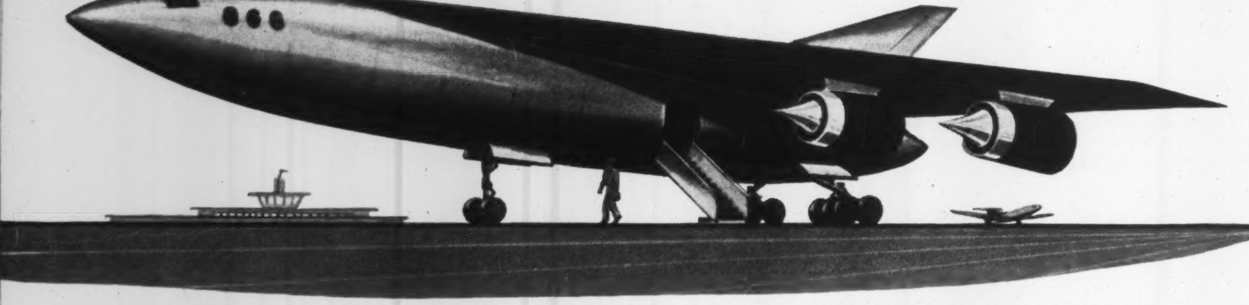
All auxiliary power systems considered here have the common problem of maintaining the structural integrity of large radiator or collector structures in the face of continuous bombardment by interplanetary particles.

Meteoroids of size less than roughly 0.3 cm are indiscernable by visual, photographic, or radio-reflection techniques. Hence any estimate of numbers, velocities, masses, and other fundamental characteristics of the smaller particles must be extrapolated from direct observation of larger bodies and from indirect evidence such as particle scattering of sunlight, impact on high-altitude rockets and earth satellites, the study of minute particles found on the earth's surface, and the accretion of this material in ocean-bottom deposits.

In the absence of both adequate theory and experimental data on the impacting effects of hypervelocity dust particles, no good estimate of the erosive or puncture effect of these particles is available.

When large surfaces are used which cover or support channels carrying working fluid to be cooled for reuse in the conversion cycle, a tabulation of average erosion rate is less pertinent than a calculation of the probability of the channel being penetrated by a particle and consequently causing loss of working fluid.

To combat deterioration in performance, a radiator can be segmented in such a way that, if one section is destroyed or shows leakage, it can be cut off from the rest of the radiator area. A second method is to use so-called meteor bumpers, which are thin sheets placed in front of the primary surface and which volatize the incoming meteoroids to hot gases which have relatively little effect on the main surface.



Hypothetical Mach 3 ramjet transport

RAMJET SUPERSONIC

THE RAMJET engine, successful in the Bomarc, X-7, Talos, and Bloodhound missiles, can also be adapted to long-duration cruise.

Actually, the word "ramjet" merely indicates a certain thermodynamic cycle, while a specific ramjet engine may be designed to do any of a number of radically different jobs. A transport engine would be designed to operate at low temperatures (lower, in fact, than turbojet temperatures) and the emphasis would be on efficiency and long life rather than on maximum thrust.

The ramjet, of course, will not produce static thrust. This does not mean that the ramjet is not a practical aircraft engine; it means that it must be a part of a propulsion system.

We believe that ramjet propulsion systems offer the safest, most reliable power for long-duration transport cruise operation in the speed range of present supersonic transport studies. Fixed-geometry, low-combustion-temperature ramjets suitable for transport cruise operation in the Mach 2.5 to 4.0 speed range have demonstrated durability and reliability at conditions simulating Mach 3.5 at 80,000 ft with a fuel-air ratio of approximately 0.04.

So Beautifully Simple

Fixed-geometry ramjets offer the following advantages obviously leading to safety, reliability, and low maintenance cost:

Zero Rotating Components. Engine failures are not catastrophic. Low-stressed fixed components are not as sensitive to thermal shock as highly loaded compressors and turbines. Minimum vibration levels add to over-all engine durability.

Zero Moving Parts. Chafing and wear are entirely eliminated with suitable materials in those areas requiring protection from combustion-gas corrosion and erosion. Unknown maintenance costs of continuous-duty high-temperature-engine, variable-exit components are eliminated.

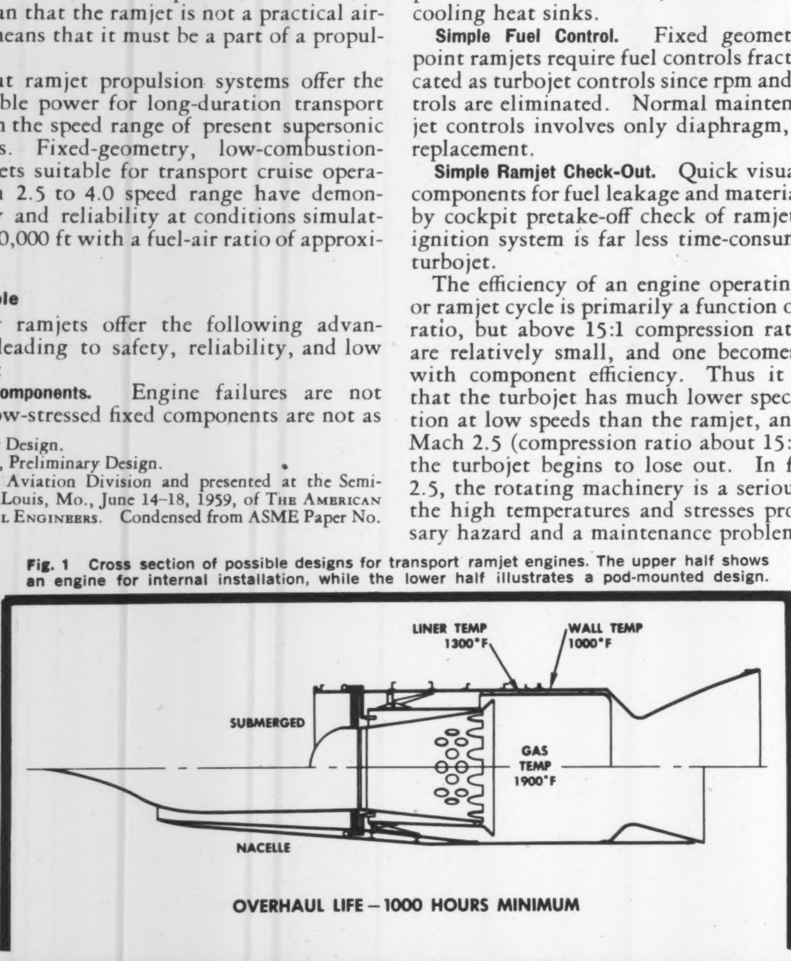
Lubrication-System Elimination. Exotic lubricant and seal problems are nonexistent, as are the complexities of oil-cooling heat sinks.

Simple Fuel Control. Fixed geometry, single-design-point ramjets require fuel controls fractionally as complicated as turbojet controls since rpm and variable exit controls are eliminated. Normal maintenance of such ramjet controls involves only diaphragm, seals, and gasket replacement.

Simple Ramjet Check-Out. Quick visual check of ramjet components for fuel leakage and material failure followed by cockpit pretake-off check of ramjet fuel control and ignition system is far less time-consuming than for the turbojet.

The efficiency of an engine operating on the turbojet or ramjet cycle is primarily a function of the compression ratio, but above 15:1 compression ratio the differences are relatively small, and one becomes more concerned with component efficiency. Thus it surprises no one that the turbojet has much lower specific fuel consumption at low speeds than the ramjet, and at speeds above Mach 2.5 (compression ratio about 15:1 for the ramjet), the turbojet begins to lose out. In fact, above Mach 2.5, the rotating machinery is a serious handicap, since the high temperatures and stresses produce an unnecessary hazard and a maintenance problem.

Fig. 1 Cross section of possible designs for transport ramjet engines. The upper half shows an engine for internal installation, while the lower half illustrates a pod-mounted design.



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[1] Chief, Preliminary Design.

[2] Section Supervisor, Preliminary Design.

Contributed by the Aviation Division and presented at the Semi-Annual Meeting, St. Louis, Mo., June 14–18, 1959, of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Condensed from ASME Paper No. 59—SA-38.

The ramjet,
simplest of engines,
may provide cruising
power for airliners
flying at Mach 3

By J. F. Drake[1] and R. T. De Vault[2]
Marquardt Corporation
Van Nuys, Calif.

TRANSPORTS

As to the metal temperatures in typical Mach 3 engines operating at the same thrust:

1 The ramjet burner assembly operates at about the same temperature as the turbojet primary burner.

2 The turbojet turbine components operate at temperatures higher than any ramjet components.

3 The turbojet afterburner assembly operates at higher temperatures than any ramjet component, since it must operate in the hot turbine-exhaust gases.

4 The turbojet afterburner liner operates at a higher temperature than the ramjet liner since the ramjet liner is cooled by unheated ram air.

Ramjets designed for transport use may look something like the design shown in Fig. 1. In the internal case, the exit is allowed to expand to a larger area, since this is usually a drag advantage, rather than a drag penalty, for engines installed at the base of a body designed for supersonic cruise.

Point Design

The attainable performance of such designs is shown in Fig. 2, which is a plot of corrected net jet thrust against net jet specific fuel consumption. These data give the performance of a series of point-design engines; i.e., the required engine geometry varies along the curves, each point representing a different fixed-geometry engine. Thus the high and low thrust levels shown cannot be obtained with the same fixed-geometry engine at the values of specific fuel consumption shown. The design operating point must, therefore, be chosen with care, and if large thrust variations with low specific fuel consumption are required, variable engine geometry must be used.

Estimated engine-weight data for submerged-type installations is indicated in Fig. 3. A series of design-point ramjet engines, based on a q = 1000 psf structural limit,[3] was studied over the range of Mach numbers from 2.0 to 3.0.

The application requires a lean fuel/air (0.020) engine for optimum performance and this requirement was included in the heat-transfer studies. A range of engine

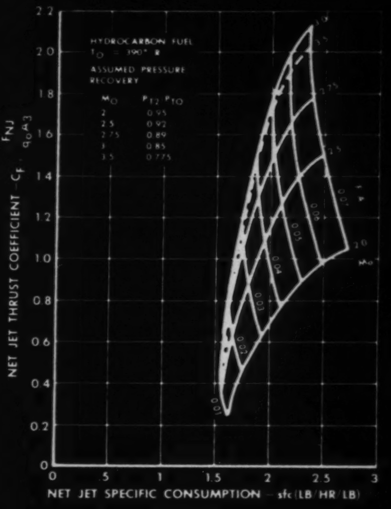

Fig. 2 Ramjet engine performance, thrust vs. specific fuel consumption. The fixed-design ramjet operates efficiently only at its "design point," a major problem. To calculate each point requires 15 min on an IBM computer—36 million operations, with thousands of iterations. Engines allowing variable geometry are under development.

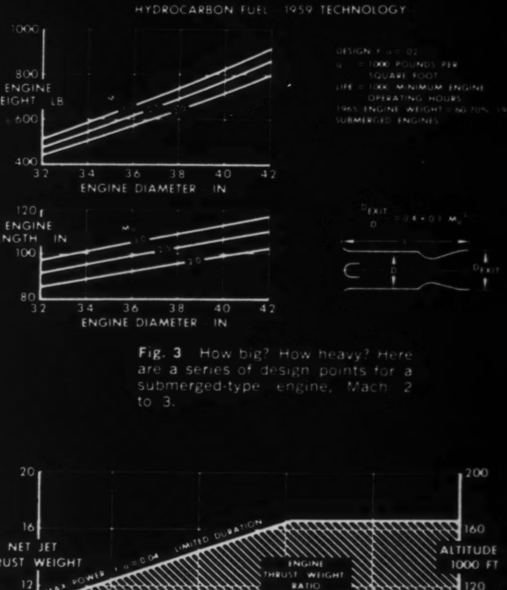

Fig. 3 How big? How heavy? Here are a series of design points for a submerged-type engine, Mach 2 to 3.

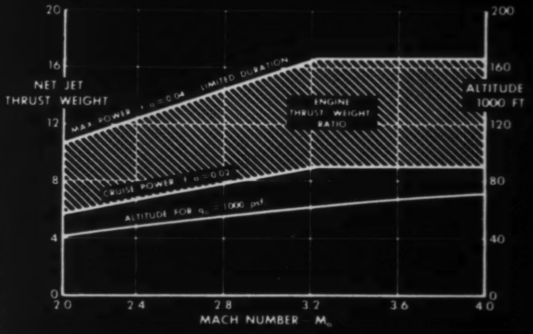

Fig. 4 Thrust-weight ratio. "Cruise power" represents a point-design, fixed-geometry engine, operating at its design condition.

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[3] q is the dynamic pressure of the air rushing past the vehicle, in lb per sq ft.

diameters from 32 to 42 in. is included to provide flexibility in selection of the engine size. Marquardt design criteria used for this engine insure 1000 hr minimum life. Further, the design capability is believed to exceed 2000 hr life with normal refinement (and no significant weight increase) of marginal areas indicated by service experience.

The engine weights represent estimates using current production materials and techniques. In the operation period of 1965, a weight reduction of 30 to 40 per cent may be realized as a result of improved materials and fabrication processes.

The thrust-weight ratio for these engines is presented in Fig. 4. The curve labeled "max power" applies to a case where the exit area may be varied a moderate amount. The "limited-duration" note is on the curve since somewhat higher gas temperatures are required to obtain the higher thrusts and the engine weights given here do not allow for continuous operation at these conditions.

It is proposed to compare the propulsion system using ramjets to the best system not using ramjets.

The Price Tag is Low

Ramjet-installation first costs are naturally lower than equivalent turbojet engines, due to the greater simplicity. Although ramjet maintenance costs cannot be substantiated by service records as easily as turbojets, the absence of rotating components would indicate that the service life and maintenance costs of ramjets should be more favorable even than the fixed components of turbojet engines. As yet, service life and maintenance costs of continuous duty Mach 2.5 to 3.0 turbojets are unknown.

The airframe characteristics assumed here have been taken from the literature. Since most interest seems to be in the Mach 3 cruise case, this is the one considered. An initial cruise altitude of 60,000 ft was assumed.

Take-off, climb, and acceleration trajectory was held as close to the minimum-fuel-consumption path as possible, keeping $q = 1000$ psf, and avoiding disconcerting manuevers.

A Breguet cruise path was used (assuming the development of adequate acceleration trajectory curve), at the end of which a minimum power, maximum L/D let-down occurred to subsonic flight. An allowance of fuel for 15 min subsonic flight at 5000-ft altitude was made in both cases. The flight envelope of the aircraft with the flight trajectory is presented in Fig. 5. The altitude-range plot is given in Fig. 6.

The turbojets used in the combined system will be conventional, although we would expect them to be somewhat lighter than today's models. The Mach 3 turbojet, on the other hand, will be conventional only in a superficial way. Its materials, cooling, and lubrication and control systems will have to be much more sophisticated than current practice. Fig. 7 tabulates the characteristics of the two propulsion systems.

There are at least three critical points in the flight path that may determine engine size and may influence the engine design. These are take-off, transonic acceleration, and cruise.

The Combined System

If only one power plant is used, it must be compromised to handle all three jobs. In the case of combination systems, the turbojet design may be optimized for low-speed acceleration and the ramjet design may be optimized for cruise. For this study, the same turbojets were used in both systems. A more realistic approach, favorable to the ramjet case, would be to use higher-pressure-ratio-boost turbojets that would use less fuel during climb, descent, and holding.

The economic comparison of the ramjet and turbojet Mach 3 transports is based on the direct operating cost as shown in Fig. 9.

The cost methodology is similar to that used by the Air Transport Association and generally accepted by the airline and aircraft industry. Values for each cost item have been determined by use of relationships based on direct airline experience as reported in CAB Form 41, where applicable, as well as those values expressed in the ATA formula. In addition, consideration has been given to the effect on cost values of operations conducted at supersonic speeds. The same ground rules have been applied to both the ramjet-turbojet combination and the straight turbojet.

The number of seats selected for the Mach 3 aircraft was determined from seating configurations of subsonic jet transports presently in service or about to come into service. A figure of 140 seats is representative of present thinking. Since frequency of service, as well as seating capacity, is of considerable importance to air carriers, there appears no reason to project larger seating capacities for supersonic transports. The 140-seat configuration has, therefore, been selected for unit-cost purposes in this paper.

The individual cost items considered pertinent to the DOC[4] are fuel and oil, depreciation and insurance, direct maintenance, and flight crews.

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[4] Direct operating cost.

Fig. 5 The "flight envelope," showing the flight path. Because of the noise problem, the minimum altitude for Mach 1 is considered to be 35,000 ft.

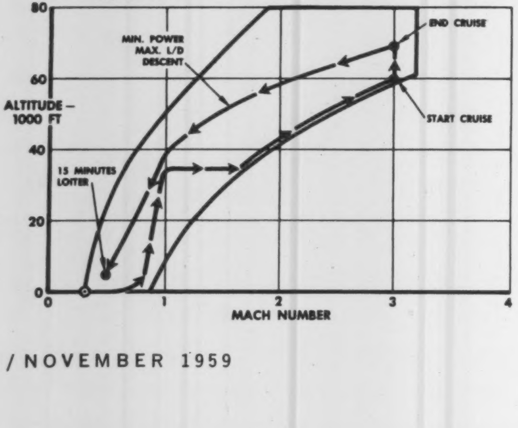

Fig. 6 The "Breguet flight path" is one in which a constant angle of attack is held, keeping L/D constant. Plane gains altitude along the path.

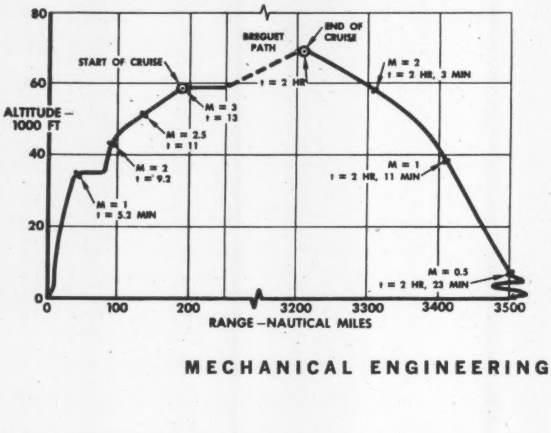

Table 1 Comparison of Fuel Used During Climb and Cruise

	Fuel used during climb		Fuel used during cruise		Total fuel climb and cruise	
	Per cent TOGW	Lb	Per cent TOGW	Lb	Per cent TOGW	Lb
Ramjet-turbojet.....	13.0	29800	26.7	61100	39.7	90900
Turbojet only.......	14.4	40000	30.0	83400	44.4	123400

For the purposes of this paper, it is the relative comparison of the two transports which is significant rather than the absolute values. Since no completely standardized method is available for cost analysis on the supersonic transport, one must use care when comparing directly the absolute value of the DOC with other studies.

Fig. 8 compares the resultant weights of Mach 3, 3500-nautical-mile, 140-passenger transports using the two engine systems. The take-off gross weight of the straight turbojet transport is approximately 20 per cent greater than the transport using the ramjet cruise—turbojet boost system.

Characteristic of both systems is the large amount of fuel carried, approximately 50 per cent of the TOGW.[5]

Fig. 9 shows the direct operating cost of both systems. The large fuel capacity, plus the extremely high hourly rate of fuel consumption, results in the fuel cost being by far the largest single factor in the direct operating cost. Extremely high productivity of the Mach 3 transport, on the other hand, keeps the total operating costs to a level lower than present-day subsonic jet transports.

The Ramjet Is Indicated

The 20 per cent advantage in DOC, shown by the ramjet-powered transport, is due to the smaller amount of fuel required over the straight turbojet system. Fig. 8 shows that the fuel savings of the ramjet engines, 5 per cent TOGW, more than offset their added weight, 2 per cent TOGW, for a net gain, 3 per cent TOGW, in payload. Since the payload is only 13 per cent of TOGW for the turbojet case, the extra 3 per cent increases the payload and productivity by a significant 20 per cent.

For the same payload, the over-all size of the plane can be reduced 20 per cent with ramjets with a corresponding saving in direct operating costs.

Fuel savings in the ramjet systems are the result of the quicker climb to cruise altitude with the added ramjet boost, and the better cruise SFC due to the inherently better efficiency at Mach 3. Table 1 summarizes these important weight savings.

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[5] Take-off gross weight.

Fig. 7 Weight and fuel consumption, turbojet system vs. combination turbojet-ramjet, in supersonic transports.

	FLIGHT CONDITION	POWER SETTING	MACH 3 TURBOJET SYSTEM	RAMJET-TURBOJET SYSTEM	
				RAMJET	TURBOJET
ENGINE — THRUST/WEIGHT	SEA LEVEL — STATIC	MAX	5.0	—	5.0
	MACH 1.5 @ 35,000 FT	MAX	3.90	4.87	3.90
	MACH 3.0 @ 60,000 FT	CRUISE	1.94	6.65	—
SFC — LB/HR/LB	SEA LEVEL — STATIC	MAX	2.0	—	2.0
	MACH 1.5 @ 35,000 FT	MAX	2.0	3.0	2.0
	MACH 3.0 @ 60,000 FT	CRUISE	1.90	1.57	—

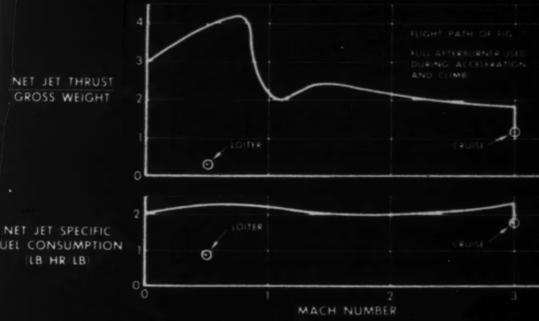

Fig. 8 Assumed performance of a turbojet engine for a Mach 3 transport (flight path of Fig. 5)

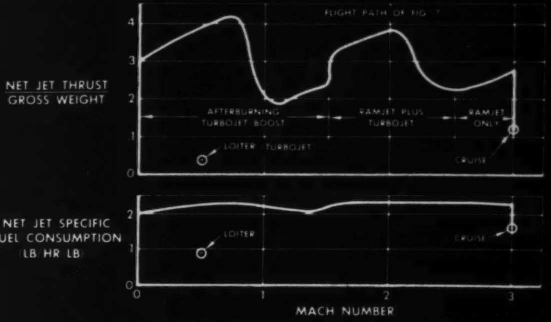

Fig. 9 Performance of a ramjet transport propulsion system with turbojet booster (Mach 3)

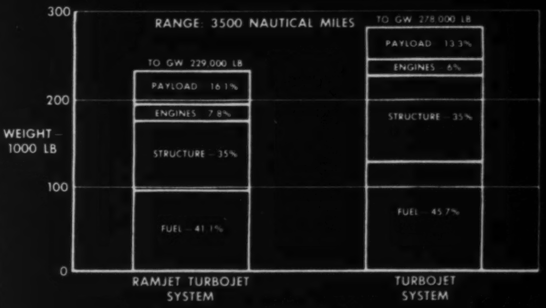

Fig. 10 Weight breakdown of ramjet and turbojet propulsion systems for a Mach 3 airline transport

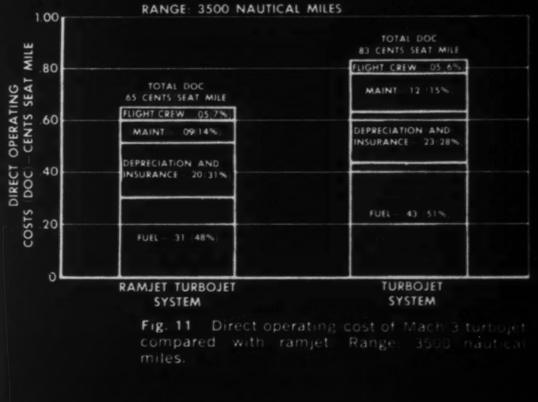

Fig. 11 Direct operating cost of Mach 3 turbojet compared with ramjet. Range: 3500 nautical miles.

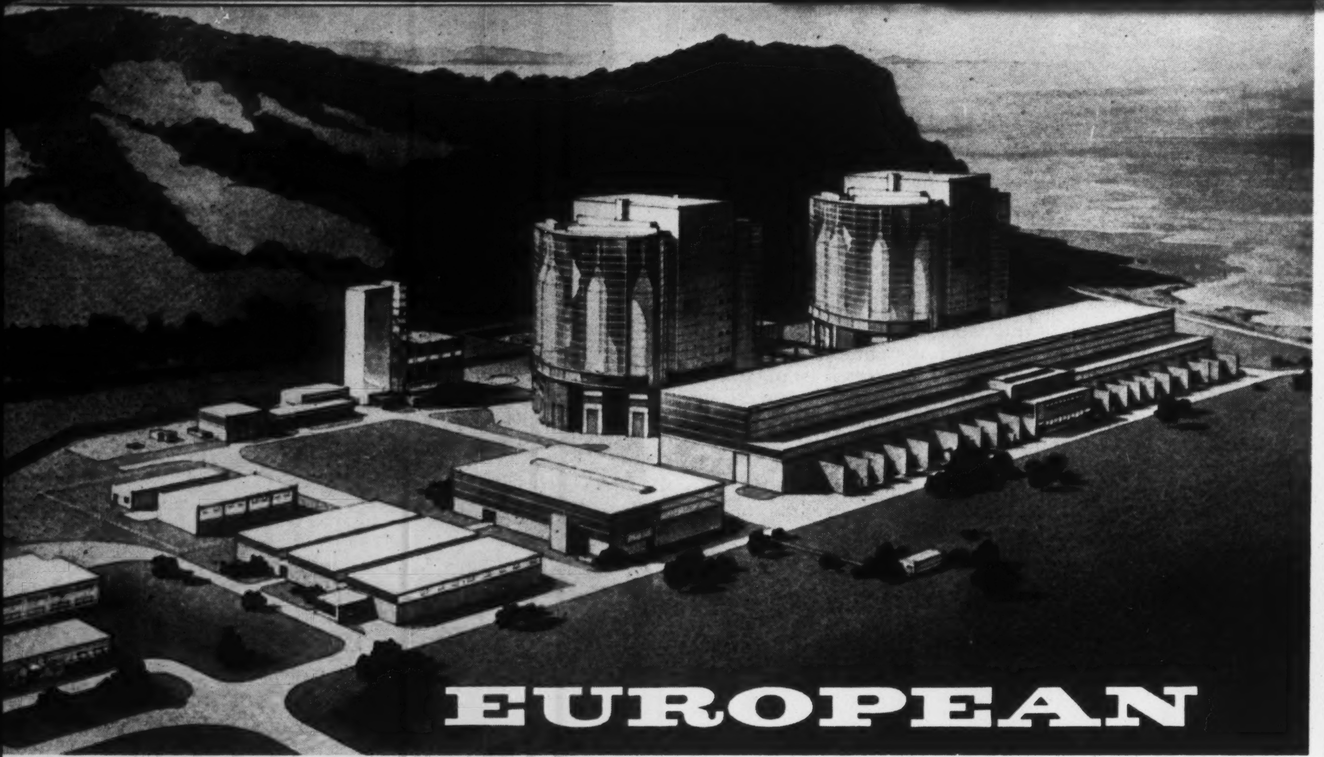

Fig. 1 The Hunterston nuclear power station on the shore of the Firth of Clyde in southwest Scotland, as it will appear when completed

EUROPEAN POWER REACTORS[1]

UNITED KINGDOM · FRANCE · ITALY

France and Italy make progress in their drive for nuclear power for industry. In the United Kingdom, the basic problems have been solved. Now the race is for reliability and ease of maintenance.

Power reactors in the three European countries with the largest nuclear development programs were described at the Fifth Nuclear Congress. The United Kingdom, first to achieve commercial nuclear power, continues to concentrate on the gas-cooled graphite-moderated type. Over 2,000,000 kw of electrical output are either operating or in advanced stages of construction. Much of this is designed to be competitive in cost with fossil-fuel-generated power, and an advanced gas-cooled-reactor concept should realize the economy originally predicted for nuclear power.

On the continent, both France and Italy have sizable research and development programs of their own, and are also participating in Euratom and other international programs. France is building two gas-cooled graphite-moderated reactors primarily for plutonium production, but with some electric generation. These are unique in having prestressed-concrete pressure vessels which also serve as biological shields. Italy's power-reactor program is diffuse as to type—one boiling-water, one pressurized-water, and one gas-cooled plant. These are being constructed by American and British concerns.

UNITED KINGDOM

Although the entire program for commercial power reactors in the United Kingdom is being concentrated on the gas-cooled graphite-moderated type, each station has unique features. Basic design consists of two reactor buildings connected to a common turbine hall, but technological progress has been rapid and is being incorporated into each design as development proceeds. Since the basic problems have been solved, and the reactor type has been proved, there is concentration on the economics of nuclear power generation.

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[1] Based on a group of eight papers contributed by the Nuclear Engineering Division of The American Society of Mechanical Engineers and presented at the Fifth Nuclear Congress, Cleveland, Ohio, April 5–10, 1959, co-ordinated by the Engineers Joint Council.

HUNTERSTON[2]

The HUNTERSTON power station, under construction in southwest Scotland, about 30 miles from Glasgow, will comprise two reactors with a total net guaranteed output of 300 emw. The installed gross capacity of this station, being built for the South of Scotland Electricity Board, will be 360 emw, allowing net output to be raised to about 320 emw as developments proceed.

The reactors are of the natural-metallic-uranium, CO_2-cooled, graphite-moderated type on which British industry is concentrating. Although there was close liaison with the United Kingdom Atomic Energy Authority, the Hunterston reactors were designed to be competitive producers of commercial electricity and differ in many respects from those at Calder Hall.

One of the principal distinguishing features will be the charging and discharging of the fuel elements with the reactor coolant at full pressure and with the station generating its full output. All foreseeable maintenance operations can also be carried out without taking the station off line, or, in most cases, shedding load.

The nuclear side of the plant has been designed to permit normal load variations up to 10 per cent per minute, although the turbogenerators would probably limit load changing to about 5 per cent per minute.

Another major difference between the Hunterston and Calder Hall reactors is the adoption of a two-shell construction for the main reactor pressure vessels. The inner shell is not designed to withstand any great pressure differential but can shield the pressure vessel proper from the hot gases emerging from the upper ends of the channels. This design permits the use of an aluminum killed steel, known commercially as Coltuf 28, for the reactor vessel. This steel is suitable for welding on site in the required thicknesses, has an excellent history as a pressure-vessel plate, and shows a low ductile-to-brittle fracture transition temperature. The creep resistance at elevated temperature is by no means ideal, but the use of the inner lining gets around this difficulty.

State of Construction

The construction methods chosen as most economic and expeditious involved the use of a Goliath crane which dictates the layout of the station to some extent. The reactors have to be placed in line and separated from the turbine hall, while space has to be left for pressure-vessel fabrication and other work at the end of the line of the two reactors. Additional cranes have to be provided for construction of the turbine hall. The appearance of the completed station is shown in Fig. 1.

The foundations and main shield walls of reactor A are complete. Prefabrication of the main pressure vessel in 3-in-thick plate is nearing completion and erection of the support course and lower rings of the vessel inside the biological shield has started, Fig. 2. The foundations of reactor B are complete and work on the shield walls is under way.

The turbine hall is proceeding on schedule and the turboalternator foundation blocks are now being cast, Fig. 3.

Design Features

The accident to the UKAEA Windscale reactor, together with much experimental data, has shown that it is undesirable in a commercial reactor to design for periodic release of the Wigner energy built up in graphite. The moderator temperatures at Hunterston have been

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[2] Condensed from "The Hunterston Project and the Future Development of The Gas-Cooled Power Reactor," by K. J. Wootton, manager, Atomic Energy Division, The General Electric Company, Ltd., Erith, Kent, England. Paper No. V-63. (Papers are available only from Engineers Joint Council, 29 West 39th Street, New York 18, N. Y., at 50 cents each. ASME Coupons cannot be used.)

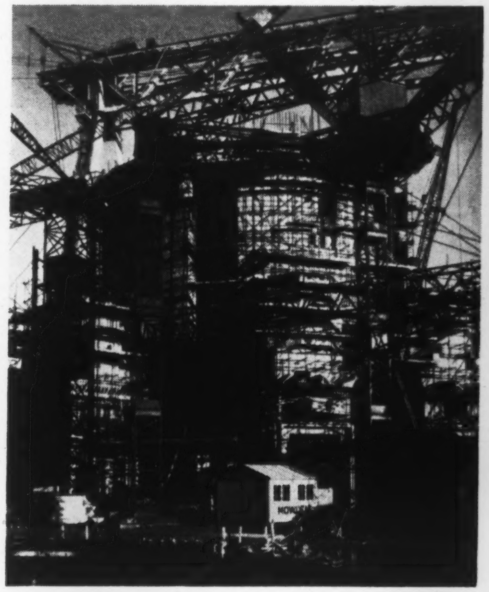


Fig. 2 The reactor A building at the end of 1958. Foundations had also been laid for reactor B.

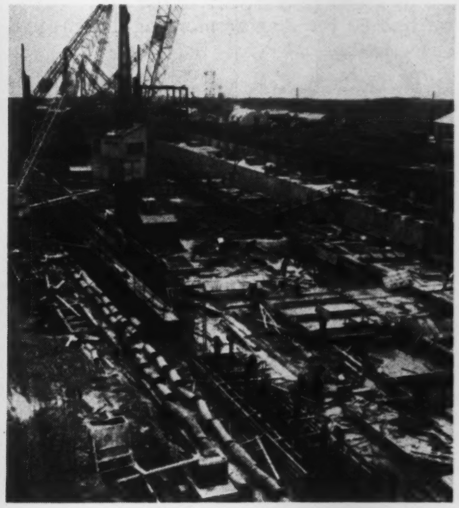


Fig. 3 The condition of the turbine hall for the Hunterston reactors as it appeared near the end of 1958

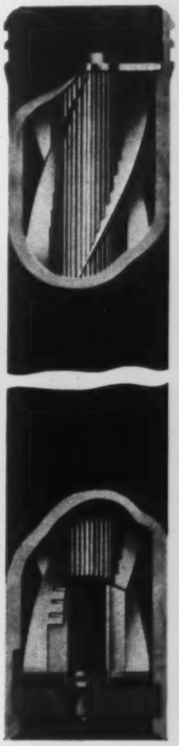


Fig. 4 A fuel-element assembly for the Hunterston reactors. The natural-uranium rods are Magnox-canned and provided with helical fins to provide maximum contact of the coolant gas with the metal surface. Graphite sleeves permit the minimum temperature of the bulk of the graphite moderator to be maintained above the gas-inlet temperature.

raised to reduce the rate of this energy storage. A relatively high return-gas temperature, 200 C, was adopted and the fuel elements were provided with impregnated graphite sleeves, Fig. 4. These sleeves form a lining to the reactor channels and, by controlling gas flow in the annuli between sleeves and moderator blocks, the minimum temperature of the bulk of the graphite moderator can be maintained above the gas-inlet temperature, if required. The Hunterston reactors should run for at least 50 years at 80 per cent load factor before a Wigner release becomes desirable.

The sleeve meets design requirements for individual support of each uranium rod, protection of bulk of moderator from oxidation by CO_2, and other conditions. The sleeve also permits modifications to be made in the design of the fuel element proper, and in the operating conditions of the element and moderator even at a late stage of construction. Throughout the design, advantage has been taken of progress and developments which have occurred since the station was conceived.

Future Developments

To date, design studies of alternatives and the development of a wide variety of schemes in the U. S. and elsewhere have given no reason to abandon the gas-cooled graphite-moderated type for the size of power reactor at present under consideration. On the contrary, it has been shown that the gas-cooled reactor can be steadily reduced in capital costs and kept fully competitive, using natural or near-natural uranium, with outputs from 40 to 400 emw.

Currently, methods of raising the maximum temperature of the coolant and reducing the volume of the pressure vessel for a given heat output are being developed. An obvious way of obtaining an increase in gas temperature is to use beryllium as a canning material in place of the present magnesium alloys although there are formidable technological problems. An Advanced Gas-Cooled Reactor having beryllium-canned fuel elements is now being built by the UKAEA on the Windscale site. If successful, it may serve as a prototype for the next round of power reactors in Britain.

Much attention is being given in the U. K. to the percentage availability of reactors when incorporated in a commercial power station. High efficiency or low capital cost is valueless to a utility company unless the station can remain on line 80 per cent or more of the hours in a year for the next 20 years or so. This search for reliability and ease of maintenance is considered correct even though it may result in a rather conservative approach to certain aspects of reactor development.

BERKELEY[3]

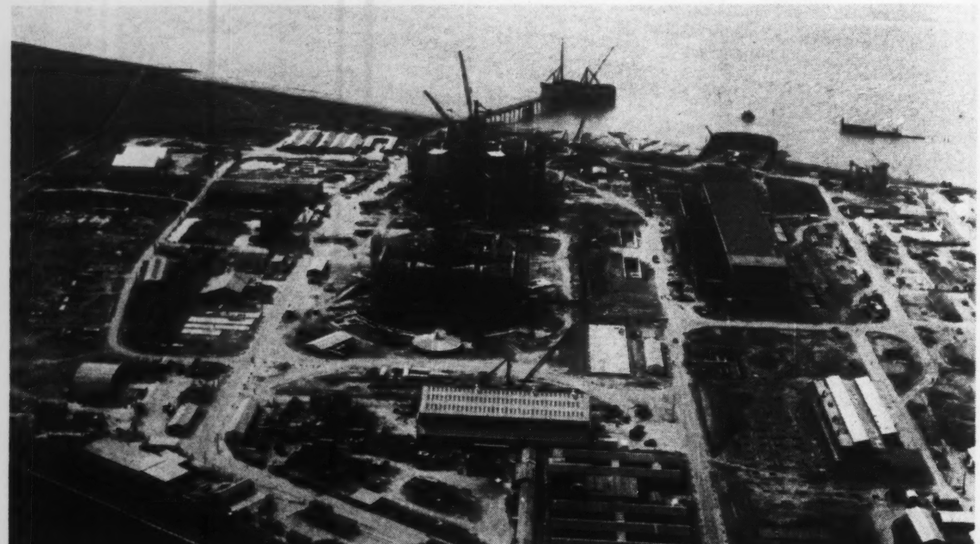
Berkeley, one of the two power stations in the original nuclear station design competition in 1956, is also a CO_2-cooled, graphite-moderated, two-reactor station, Figs. 5, 6, and 7. It is being built for the Central Electricity Generating Board on the River Severn in Gloucestershire, England. It has the lowest output, 275 mw, lowest over-all efficiency, 25 per cent, and lowest steam conditions of any of the five reactors now under construction in Great Britain. For the h-p portions, steam conditions are 300 psig at 612 F, and for the l-p portions they are 72 psig and 612 F. Berkeley has a cylindrical, not a spherical, pressure vessel.

Over-All Thermal Efficiency and Steam Conditions

The steam conditions and thermal efficiency are dictated by the economics of power generation. At the present stage of development of the gas-cooled reactor, and under typical British financing conditions, only 30 per cent of the total kwhr sent-out cost is attributable to fuel-consumption charges, while capital charges account for 54 per cent. Fuel charges for a corresponding coal-fired station can account for 74 per cent of the kwhr cost, with capital charges contributing less than 20 per cent. Consequently, whereas the coal-fired-station operator is extremely concerned with the effect of over-all thermal efficiency on kwhr sent-out cost, the nuclear-station operator considers fuel consumption to be of secondary importance compared to the reduction of capital charges.

The safe working temperature for Magnox cans—a magnesium-alloy fuel-element canning material—is 475 C. While the reactor is fully instrumented and the charge-discharge machinery has extremely generous margins to cope with a high fuel-can burst rate, to insure an economic fuel life, it is advisable to be extremely conservative. Thus a gas-outlet temperature of 350 C was chosen.

Fig. 5 The construction site for the Berkeley nuclear power station on the River Severn in Gloucestershire, England. Like Berkeley, it is a two-reactor and turbine-hall combination.



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[3] Condensed from "The Berkeley Nuclear Power Station and Its Influence on Future Developments," by A. L. Shaw, assistant to chief engineer, A.E.I.-John Thompson Nuclear Energy Company, Ltd., Radbroke Hall, Knutsford, Cheshire, England. Paper No. V-64.

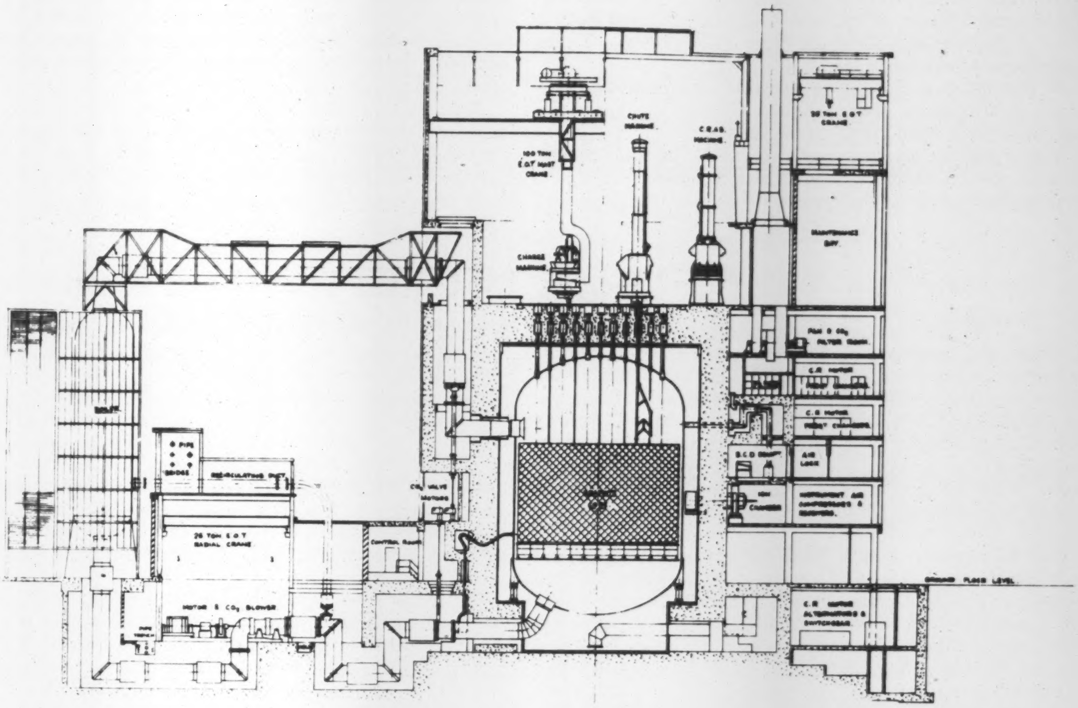
100 TON E.O.T. HOIST CRANE
CHUTE MACHINE
C.R.A.B. MACHINE
30 TON E.O.T. CRANE
MAINTENANCE BAY
CHARGE MACHINE
PIPE BRIDGE
RECIRCULATING DUCT
CO₂ VALVE MOTORS
25 TON E.O.T. RADIAL CRANE
CONTROL ROOM
MOTOR & CO₂ BLOWER
PIPE TRENCH
FAN & CO₂ FILTER ROOM
AIR LOCK
ION CHAMBER
INSTRUMENT AIR COMPRESSORS & RECEIVERS
GROUND FLOOR LEVEL
SWITCHGEAR

Fig. 6 Vertical section through one of the Berkeley reactors and one of eight radially arranged boilers. Coolant gas from the core furnishes heat for steam generation.

Since core output rises with reduction in inlet temperature 160 C was adopted.

Study of the steam-cycle possibilities between these two boundary temperatures explains the low steam conditions, whose economic effect was taken into account.

Construction Progress

On January 1, 1959, the welding of the 3-in-thick pressure vessel for the No. 1 reactor assembly was complete, with nearly all the standpipe holes in the top dome cut and prepared for stub welding.

The side walls of the main biological shield were complete up to the final charge-face level, while above the charge face the building shell was approaching completion. The charge-face-floor main steelwork was in position. Seven of the eight boilers had been erected, four with clean-conditions houses completed. Tubing was in progress on three.

The pressure vessel for No. 2 reactor was complete up to the top of the barrel. The main biological-shield walls were complete to charge-face level. In both No. 1 and 2 reactors the blower houses and annexes were in advanced stages.

The main shell of the turbine house was complete with four turbine condenser shells in position and tubing in progress. Erection of the low-tension switchgear was also in progress, and pump house and main-station workshop buildings were advanced. The total labor force was near peak at 2000.

Future Developments

While each Berkeley reactor with a 50-ft-diam pressure vessel has a net electrical output of 138 mw, a

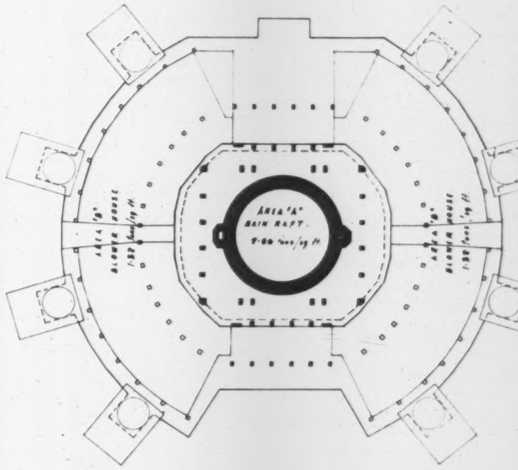
AREA "A" MAIN RAFT
AREA "B" BLOWER HOUSE
AREA "B" BLOWER HOUSE

Fig. 7 Ground plan of one of the reactors at Berkeley. The central containment structure is flanked by blower houses and the radially arranged boilers.

40-ft-diam vessel could now be designed commercially for 150-mw output, or 250-mw could be obtained from a reactor slightly smaller than those at Berkeley. These could be commissioned by 1963.

A year later it should be possible to commission reactors with specific heat ratings exceeding the 3 mw per ton obtainable from current designs.

There will be further slight advances in reactor performance with Magnox-canned fuel elements. A really striking advance should take place in the reactors commissioning in 1965 and 1966 when an improved canning material will permit a notable increase in outlet-gas temperatures with corresponding improvements not only in reactor-specific-heat rating but also in the steam conditions as delivered to turbines.

After 1970 it may be possible to commission reactors based on the high-temperature gas-cooled system utilizing novel forms of uranium fuel yielding specific-heat ratings much higher than the 7.75 mw per ton expected from the Advanced Gas-Cooled Reactor prototype.

FRANCE[4]

At Marcoule, in the south of France, two 32-emw-net, graphite-moderated, gas-cooled, natural-uranium reactors, called G2 and G3, are being built under the leadership of the Commissariat à l'Energie Atomique and Electricité de France. Many French companies co-operated in this work, the most important of which are grouped in the France-Atome organization. The Société Alsacienne de Constructions Mécaniques was general contractor. These reactors have a number of unusual features.

The G2 reactor, which went critical in July, 1958, began supplying 9 mw of electrical power to the civilian consumer grid in April. France's first plant entirely for the production of electricity, EDF-1, at Chinon, which is also gas-cooled and graphite-moderated, will begin producing 60 net emw in 1960. EDF-2, scheduled for operation at Chinon in 1961, will have a net capacity of 170 emw with two turbogenerators; and EDF-3 has a planned capacity of more than 250 net emw.

Reactor Vessels

The reactor vessels are unique in being constructed of prestressed concrete which serves the dual function of pressure vessel and biological shield. Each vessel is an 18-meter-long cylinder of 14-meter ID with a horizontal axis, and has 3-meter-thick concrete walls. Concave hemispheres at both ends extend the over-all length to about 34 meters, Fig 8. The vessel rests on a cradle which is also of concrete, and is "hooped" with steel cables for reinforcement. The total weight is 26,000 tons of which 1400 tons are steel. It is designed for 15 kg per sq cm internal operating pressures (about 213 psig) and hydraulically tested for twice that pressure.

The concrete vessel is lined with a thin steel-plate flexible skin to prevent any leakage because of the porosity of the concrete.

To prevent any residual stresses which might cause the concrete to fissure, three sets of cables provide compression, Fig. 9. These are arranged circularly, transversely, and longitudinally. The cylindrical part of the vessel has 57 circular cables covering about 250 deg of the outside circumference. Where the cables become straight, they pass through the supporting cradle and are anchored by having the wire ends spread out and hooked. These ends are then cast into concrete "knobs."

To complete the cylinder "hooping," transverse cables through the supporting structure provide a clamping action on the upper part of the cradle. An additional 46 straight horizontal cables counter the longitudinal component of the internal pressures on the hemispherical ends by passing through the full length of the cylinder walls. They end in a circle of concrete knobular anchors near the periphery of the hemispheres, Fig. 10. The concave configuration of the hemispherical ends provides resistance to the other components of the internal pressures.

Cables are prestressed by jacks arranged between the concrete wall and one of the terminal anchorages. About 1200 tons tensile stress is applied to each cable, resulting in an equivalent compressive stressing of the concrete. The steel wires used have a breaking strength of 140 kg per sq mm and an elongation at rupture of 3 per cent.

Active Core

The active core of the reactor includes the graphite moderator and the canned uranium rods. Magnesium is used in canning the 300-mm-long uranium rods. The reflector which surrounds the active core is also made of graphite of nearly the same purity as the moderator. Moderator and reflector are made of about 1200 tons of stacked 200-mm-sq graphite blocks arranged horizontally. Circular fuel-element channels are formed of adjacent blocks which have semicircular grooving lined up to extend the channels through the entire length of the pile. Fuel elements provided with longitudinal fins to facilitate cooling are loaded through the front face of the reactor until the channel is filled.

The graphite stack is completely surrounded by a thermal shield made of steel plates. Joints are provided with butt straps to reduce the radiation flow and to prevent mixing of the CO_2 gas which flows around the moderator and the reflector. Insulation is applied to the outside of the thermal shield.

A metal framework made of six main horizontal girders, each of which rests on three feet, supports the graphite and thermal-shield assembly. Provision is made for thermal expansion or contraction in all directions as the graphite is heated or cooled.

Each of the 1200 fuel-channel openings in the 5-meter-thick front face of the reactor is provided with a plug. Fuel elements are inserted by a charging machine on a movable platform with a total weight of 285 tons. The machine is lined up with a channel and air in the machine is evacuated and replaced by CO_2 at a pressure equal to that in the reactor. The channel plug is automatically unlocked and drawn back into the pressure chamber

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[4] The features of the Marcoule reactors were described in five papers: "Core Shielding and Pressure Vessels," by G. Deleuze, Société des Forges et Ateliers du Creusot, and M. Tourasse, Compagnie Industrielle des Travaux, Paper No. V-140; "On Load Refueling," by A. Ertaud and A. Pages, Société Alsacienne de Constructions Mécaniques, Paper No. V-141; "Reactor Cooling," by J. C. Chaboseau and P. J. Laferrier, Société Rateau, Paper No. V-142; "CO_2 Supply and Processing," by J. L. Hainzelin, Chantiers de l'Atlantique, Paper No. V-143; "Reactor Control," by M. Lignieres and J. Bobigeat, Société Alsthom, Paper No. V-144.

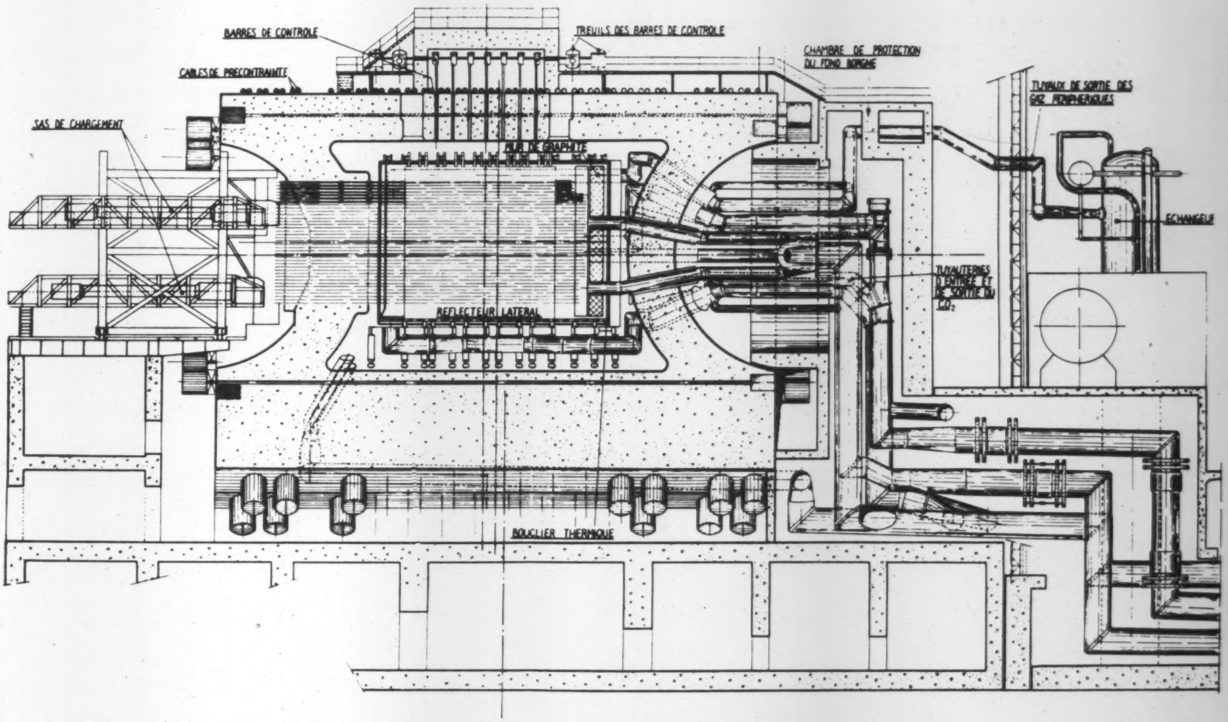

BARRES DE CONTROLE
TREUILS DES BARRES DE CONTROLE
CHAMBRE DE PROTECTION DU FOND BORGNE
CABLES DE PRECONTRAINTE
TUYAUX DE SORTIE DES GAZ PERIPHERIQUES
SAS DE CHARGEMENT
MUR DE GRAPHITE
ECHANGEUR
TUYAUTERIES D'ENTREE ET DE SORTIE DU CO2
REFLECTEUR LATERAL
BOUCLIER THERMIQUE

Fig. 8 General cross section of a Marcoule reactor. The horizontal cylindrical concrete vessel with concave ends is supported on a concrete cradle. The movable charge machine, **at left,** feeds fuel elements into the horizontal fuel channels. Vertical control rods are inserted at the top.

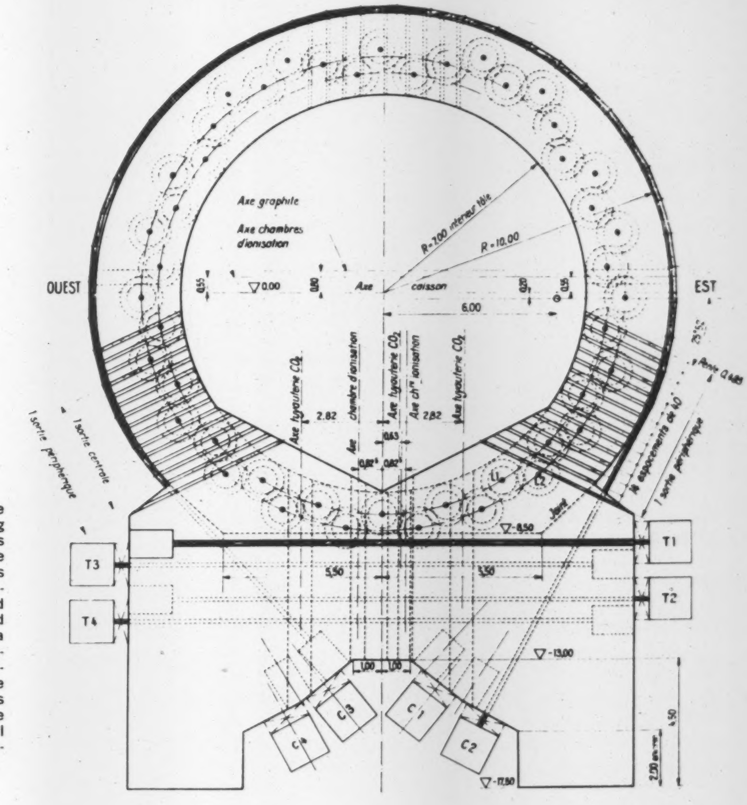

Axe graphite
Axe chambres d'ionisation
R=2,00 interieur tôle
R=10,00
OUEST
EST
0,55
0,00
0,80
Axe
caisson
0,20
0,55
6,00
Axe tuyauterie CO2
Axe chambre d'ionisation
Axe tuyauterie CO2
Axe ch^re ionisation
Axe tuyauterie CO2
2,82
2,82
0,63
0,82
0,82
25°55
Pente 0,485
14 espacements de 40
1 sortie périphérique
1 sortie centrale
1 sortie périphérique
L1
L2
Joint
-8,50
T1
T2
T3
T4
5,50
3,50
-13,00
1,00
1,00
C1
C2
C3
C4
4,50
2,50
-17,50

Fig. 9 Vertical section showing the arrangement of the compressing cables. The 57 "hooping" cables are circular for about 250 deg of the outside circumference, then pass through the cradle and are anchored, as shown, at **C1, C2, C3,** and **C4.** Transverse cables anchored at **T1, T2, T3,** and **T4** provide a clamping action on the lower portion of the vessel. The dotted circles around the periphery indicate the terminal anchors for the cables which extend linearly through the vessel to counter the longitudinal component of the internal pressures on the hemispherical ends.

behind the barrel of the charging machine. After a revolving movement of the barrel, it is charged with two fuel elements and the plug is pushed forward forcing the fuel elements into the channel.

As fuel elements are inserted at the face of the reactor they force the whole train through the channel, discharging extra elements into a steel vessel at the rear. Thus the channel is always filled, and the loading and unloading can be performed without shutting down the reactor. Uneven thermal stresses which would result from unoccupied channels are avoided, and thermal cycling of the fuel elements is reduced to a minimum.

Slugs discharge from the rear face of the reactor by a system of spouts and chutes. The spouts have a 45-deg pitch to prevent jamming and feed into helical chutes which provide centrifugal force. The added friction from the centrifugal force slows down the speed of the slugs. There are three chutes serving the spouts from different regions of the core. These feed into long horizontal tanks, still at CO_2 pressure. Vibrating carriers transfer them to terminal containers where they enter a pressure lock. When four slugs have accumulated in a lock, they are ejected into an aluminum tube at atmospheric pressure and hermetically sealed with a cold pressure weld before being sent to the cooling pond. This automatic operation includes vigorous brushing of the tubes and swaging with a double-headed machine.

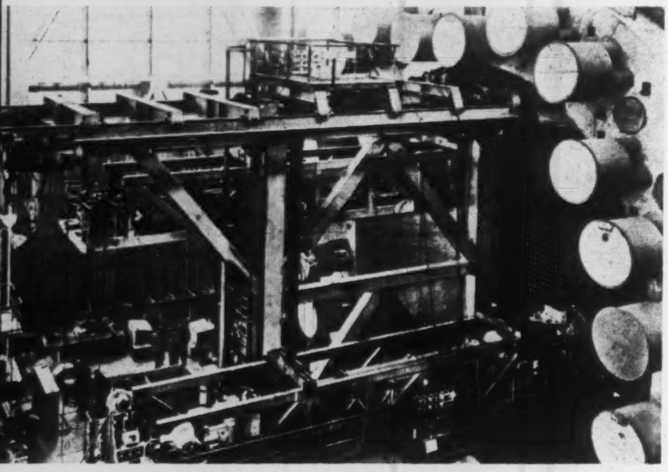


Fig. 10 The charge machine at the face of one of the Marcoule reactors. Circular drumlike structures are the knobular concrete anchors at the ends of the longitudinal cables.

In normal operation, loading is manually controlled while unloading is entirely automatic. Devices indicate the position of each slug at a given moment.

Reactor Cooling

Originally the reactor was designed for a uniform pattern of fuel-element loading which would have resulted in a radial gradient in the thermal flux pattern. To supply the peripheral channels with hotter gas than would be supplied to the core, two complete coolant systems were provided. The reactor has two supply zones and two outlet zones and a group of four heat exchangers in parallel, each with two hot-gas intakes and two cold-gas outlets. When the radial curve of the thermal flux was flattened by changing the loading pattern, crossovers were provided in the cooling circuits to enable the two main blowers to deliver gas in parallel into the pile at a substantially uniform temperature from the center to the periphery. Since gas flow in each channel was already regulated individually, no internal modifications of the coolant system were needed.

Each main blower is driven by a steam turbine operating on extraction steam of intermediate pressure. Since each blower requires 6000 hp max, turbine drive provides a simple solution to the problem of variations in coolant-gas flow and makes the system independent of any substantial outside source of electricity. Auxiliary electric-driven blowers are provided for start-up and shutdown when there is insufficient steam for the main blowers. In the event of a breakdown in the water or steam circuits of the steam generator, coolers associated with the auxiliary blowers insure extraction of heat from the core.

Secondary coolant at slightly higher pressure than that of the core circulates between the steel-sheet seal of the core and the concrete outer vessel. Emergency diesel sets provide current for the auxiliary blowers in a power failure.

CO_2 Processing and Supply

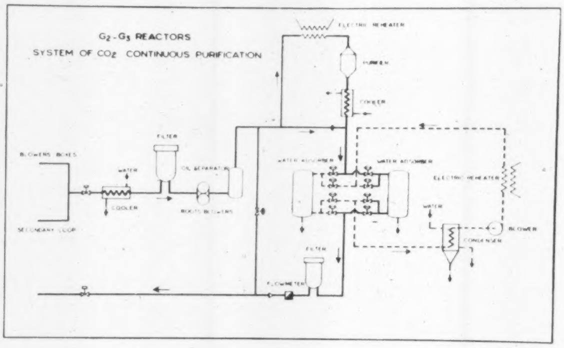
Coolant gas is purified both before introduction to the reactor and by continuous processing while in circulation. Graphite and corrosion dusts, CO produced by graphite oxidation, and hydrogen from water decomposition are among the contaminants. When a fuel slug bursts, fission products are also present.

While the amount of radiolytic decomposition of water is negligible, water promotes iron and magnesium corrosion and provides an oxidation reaction with CO which produces CO_2 and hydrogen. Hydrogen diffuses through the fuel cans and produces uranium hydride which causes can deformation. Hydrogen also produces a hydride with magnesium which would be dangerous in excess of 200 ppm in volume.

Oxidation reactions with the graphite and the reaction of CO_2 with the graphite cause a mass transfer from the core to the heat exchangers. Dusts in the coolant increase the radioactivity of the coolant system. The permissible quantities of these various impurities are still a matter for disagreement even though there has been some operating experience and theoretical studies have been made.

New gas is stored in the liquid state at −20 C. Solid

Fig. 11 Continuous-purification system for the CO_2 coolant in the Marcoule G2 and G3 reactors



particles are removed with a nylon-linen filter, and activated-alumina dryer maintains the CO_2 below the dew point—this is −50 C, measured at atmospheric pressure—and a distillation column reduces the amount of air from 1.500 ppm to less than 100 ppm. At the outlet of the purification plant, the CO_2 enters an evaporator which supplies the gas to six storing containers at a pressure between 27 and 30 kg per sq cm. These have a capacity of 250 cu meters to supply the reactor.

Oil, water, oxygen, and hydrogen are extracted in the continuous-purification plant, Fig. 11. After processing, oil and oxygen are completely removed, the dew point is below −25 C, and there are less than 100 ppm of hydrogen by volume. Dust is removed through a set of five high-efficiency paper filters located in the coolant piping system. Efficiency is 99.98 per cent for removal of dust with a diameter of over 0.3 micron. One filter can be substituted while the others remain in service.

Reactor Control

Although certain independent units require local control, the central control room is posted on the operation of all units and controls the entire installation, Fig. 12. The complete assembly of instruments comprises over 600 temperature measurements without counting those for each of the 1200 fuel channels, 176 pressure measurements, 27 level measurements, 66 flow measurements, 70 physical-safety measurements, 40 miscellaneous measurements, and 32 instrument retransmissions. Over 600 of these measurements are recorded.

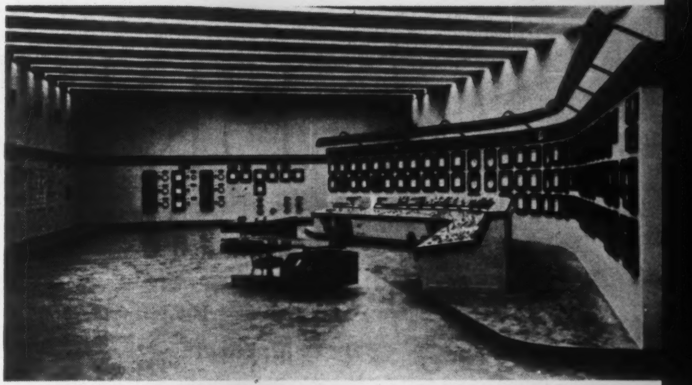


Fig. 12 Central control room for the Marcoule reactors. Over 600 of the more than 2000 measurements are automatically recorded. Although independent units require local control, the central control room is posted on all operations.

A standby station of the French power network and two emergency diesel generating sets insure that both the auxiliary equipment and the instrumentation circuits will be supplied with electricity.

The reactors have the primary function of producing plutonium with the generation of electricity as a secondary function. Each reactor was initially designed for a maximum thermal power of 150 mw, but this was raised to 200 mw by a change in the loading pattern.

ITALY[5]

In addition to a broad program of fundamental research and training for the utilization of nuclear energy in Italy, under the government-established Comitato Nazionale per la Ricerche Nucleare, CNRN, Italy is participating in the Euratom program. A study has also been made jointly by CNRN and the International Bank for Reconstruction and Development for construction of a nuclear station in southern Italy.

Power-Reactor Projects

The International General Electric Company has been awarded the contract and was chosen from bids submitted by nine different American, British, and French firms. A 150-emw, enriched-uranium, boiling-water nuclear power plant will be built by the Società Elettronucleare Nazionale, SENN, at the mouth of the Garigliano River on the west coast of Italy between Rome and Naples, with the International Bank participating in the financing.[6] The cost of power is estimated at 11.1 mills per kwhr, which is nearly competitive with the 10.2 mills for a comparable conventional thermal plant in the same area.

There are also several projects being carried on by other public or private concerns. The AGIP-Nucleare, a section of the national oil and gas combine called ENI, Ente Nazionale Idrocarburi, is building a 200-emw nuclear power station at Latina, about 50 miles south of Rome. Construction officially started in November, 1958, as the result of an agreement between AGIP-Nucleare and the British Nuclear Power Plant Company, Ltd., NPPC. This natural-uranium gas-cooled reactor is of the type that NPPC has under advanced construction at Bradwell-on-Sea, Essex. The main difference lies in the fact that while Bradwell will have two 150-emw reactors for a total of 300-emw capacity, the Latina plant will develop 200-emw with a single reactor of the same size as one at Bradwell. This is a result of a series of technological improvements worked out after the Bradwell plant was finally designed. All test drilling at the 262-acre site has been completed and modern functional buildings have been erected to house the offices and services. The internal road system has been almost completed and work is in progress for the foundation pilings of the reactor. The Latina plant is expected to supply electricity to the national grid by 1962 and produce about 1300 million kwhr a year.

In northern Italy, the Società Elettronucleare Italiana, SELNI, is planning a 134-emw power station. The leading role in this project is held by the Edison-Volta Company, and the pressurized-water-type reactor will be constructed by the Westinghouse Company.

These plants will help Italy to cope with a 7 to 9 per cent annual increase in the demand for electric power. Hydroelectric sources and the small quantity of geothermal power available have been almost fully exploited. Reserves of fossil fuel are nearly nonexistent and future power development will depend on imported fossil fuels or nuclear energy.

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[5] Based on "Nuclear Power Development in Italy," a speech given at the Joint Luncheon of The American Society of Mechanical Engineers and the American Institute of Electrical Engineers, by Nestore B. Cacciapuoti, scientific and nuclear counselor, Embassy of Italy, Washington, D. C. Paper No. V-66.

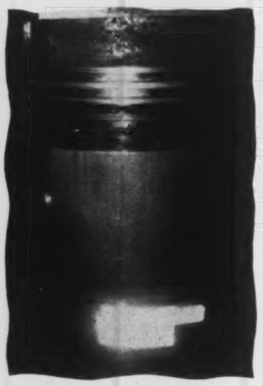
[6] The plant is described in an article by C. Matteini, president of SENN, in the May, 1959, *Nuclear Engineering*, pp. 200–203.

LUBRICATION of

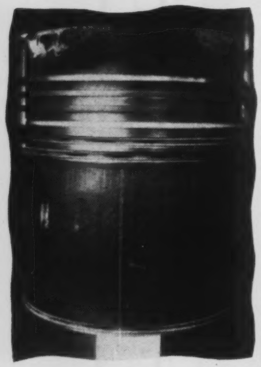
By C. M. Floyd[1]

Humble Oil and Refining Company,
Baytown, Tex.

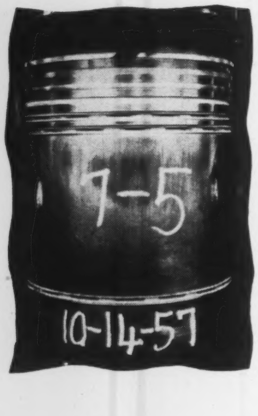
Degree of cleanliness:



Oil A, detergency level I



Oil B, detergency level II



Oil C, detergency level III

WITH the development of the natural-gas industry has come the development of relatively high-speed, high-output gas engines. The continuous and economical operation of these engines has, in turn, depended on the development of suitable lubricants.

Since most gas-engine installations contain both 2-cycle and 4-cycle engines, it is highly desirable that only one oil be required for each installation. To this end, all-purpose naphthenic detergent oils have been developed to meet a wide range of operating conditions and also to meet the economic needs of the particular gas-engine operator.

Field Tests

The author's company has been carrying out intensive field tests over the past several years. The company has some 150,000 gas-engine horsepower, representing some 300 machines of over 21 makes and models, available for study in the Gulf Coast area. Also, data were available from engines not on formal tests, which in turn helped to define some of the problems. Further information was received from the various engine builders, from discussions with lubrication engineers, and from customer engines.

The following summary points are presented from a previous report:

1 Where gas engines are kept clean through the use of good oil and good maintenance practices, wear is not a problem.

2 In 2-cycle engines in mild service, nondetergent naphthenic-base oils are superior to nondetergent paraffinic-base oils. As the severity of service increases, the use of detergent naphthenic-base oils is indicated for maximum cleanliness.

3 In the 4-cycle engine the nondetergent paraffinic-base oils are superior to the nondetergent naphthenic-base oils.

4 As the detergency levels of the two types of oils are increased, their performance becomes more nearly equivalent.

The results from extensive field engine tests show that, for the gas engines, an all-purpose oil of a detergency level that will be referred to here as Detergency Level I has been highly satisfactory. Oils containing approximately twice as much additive will be referred to in this paper as Detergency Level II. The third oil discussed here contains approximately four times as much detergent and is referred to as Detergency Level III.

The purpose of the detergent in the oil is to slow down

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[1] Research and Development Division, Manufacturing Department.

Contributed by the Oil and Gas Power Division and presented at the Oil and Gas Power Conference and Exhibit, Houston, Texas, April 19–23, 1959, of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Condensed from "A Field Study of Gas Engine Lubricants—II," ASME Paper No. 59—OGP-9.

Natural Gas Engines

Use a high-quality oil, drain at 2000-hr intervals, and use the drain oil in the compressor. Your gas engines may run 6 to 8 years at maximum efficiency.

oxidation of the oil, to pick up and hold in solution oil-oxidation products, soot, products of partial combustion, and small dust particles. A filter is provided for the removal of large dust particles and other gross particles which are too large to be carried by the oil. Since a detergent is expected to hold the products of partial combustion and oxidation in solution and suspension, these products cannot be filtered out except by filters of activated materials which also remove the additive. Therefore the proper way to maintain the crankcase oil in good condition is to drain it before these materials build up in the oil to dangerous proportions.

The 4-Cycle Engine

The power pistons of the 4-cycle engine are crankcase lubricated. Some of the problems encountered with the 4-cycle engine include high viscosity increase on crankcase oil, sludge, ring sticking, high ring wear, oil-ring plugging, and high ring-groove deposits. (This latter condition sometimes leads to ring breakage.) In the 4-cycle engines, several factors affect these conditions. Among these factors are engine condition, crankcase temperatures, filters, oil makeup rates, oil-drain periods, and, most importantly, the detergent level of the oil and the base stock of the oil.

It has been determined that wear and good performance are directly related to the cleanliness of the whole engine, but with particular emphasis on the crankcase and ring zone area. It also has been determined that the best all-purpose gas-engine oil-base stock is an intermediate VI naphthenic-base oil. To satisfy engines running under all types of conditions, it has been shown that, for constant severity of operation, as the detergency level of the oil is raised, the cleanliness of the engine is improved.

It has long been a common practice in the gas-engine industry to try to run as long as possible without oil drains. The quality of the oil was maintained at a level acceptable to the operators by changing the filters at frequent intervals. One common practice was to change the oil once per year and the filters once per month. The field test work conducted in this study has shown that changing the oil at a more frequent interval—2000 hr—and changing the filter at the same time is a more economical procedure and that engines are maintained in a much higher state of cleanliness and efficiency by these shorter drain periods.

Table 1 relates the economics of oil cost to total engine operating costs.

Even though the savings from using good drain practices appear to be great, there is resistance on the part of plant operators to changing oil at 2000 hr. Reasons given are increased labor, discarding of "good oil," and increased engine down time due to increased engine-crankcase drains. A method for encouraging crankcase drains that results in some actual savings in costs has been devised for use by gas-engine operators. This method is a pump-out system which permits the use of the crankcase oil in the compression cylinders.

A Pump-Out System

The pump-out system is operated so that the amount of oil pumped out of the crankcase is roughly equal to the amount of oil needed for the compressors. This corresponds in many cases to a 2000-hr drain period for the crankcase oil. The oil in the crankcase at the end of 2000 hr has begun to deteriorate slightly as far as the critical power cylinders are concerned. The oil is still quite satisfactory for the less critical waste-feed lubrication of the compressor cylinders. Therefore, in the pump-out system at the end of 2000 hr, the engine is stopped, the crankcase oil is pumped out rapidly to a storage tank, new oil is pumped into the engine, and the engine is restarted. This whole operation takes about 30 min.

The "used" crankcase oil from the storage tank is pumped through a filter into a wheeled lubester. The lubester is then moved from engine to engine to fill the compressor lubricator pumps. By this method the oil formerly discarded from the crankcase is used, with a savings in oil costs of $350–$500 per engine per year. The engine down time for oil changes is cut to a minimum, labor costs are reduced, and the engines are kept clean.

Again referring to Table 1, if the oil drained from the crankcase in Case II*a* and II*b* is reused in the compressor, the net savings in oil is 1000 gal per year and the monetary savings are $350 per year for Case II*a* and $500 per year for Case II*b*.

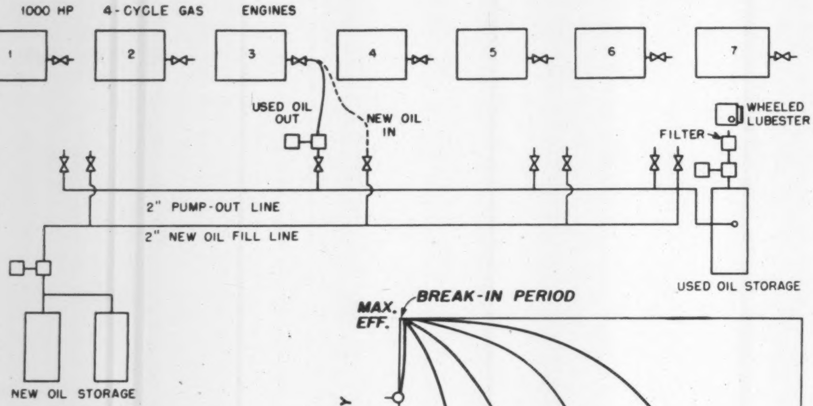
It has been determined that, when the oil is drained as

Table 1 Engine Operating Costs

Basis: 1000-Hp Four-Cycle Gas-Engine Operating Time, 8000 Hr (1 Yr)

Case	I		II	
Crankcase drain period, hr	8000		2000	
Filter change period, hr	720		2000	
	Ia	Ib	IIa	IIb
Fuel costs, $	11200	11200	11200	11200
Parts and labor, $	2000	2000	2000	2000
Oils costs, $/gal	0.35	0.50	0.35	0.50
Oils used, gal				
Compressor	1000	1000	1000	1000
Oil burned (8000 hp hr/gal)	1000	1000	1000	1000
Crankcase	250	250	1000	1000
Filter changes	400	400	160	160
Total oil used	2650	2650	3160	3160
Total oil costs	$ 927.50	$ 1325.00	$ 1106.00	$ 1580.00
Total filter costs[a]	375.00	375.00	150.00	150.00
Total annual cost	$14502.50	$14900.00	$14456.00	$14930.00

[a] Filter costs/change $37.50, waste-packed.



Pump-out system. Oil taken from crankcases at 2000 hr is then used in compressors.

often as 2000–3000 hr, the following control tests are adequate:

Viscosity increase at 100 F, not over 25 per cent.
Pentane insolubles, not over 0.5 per cent.
Benzene insolubles, not over 0.25 per cent.

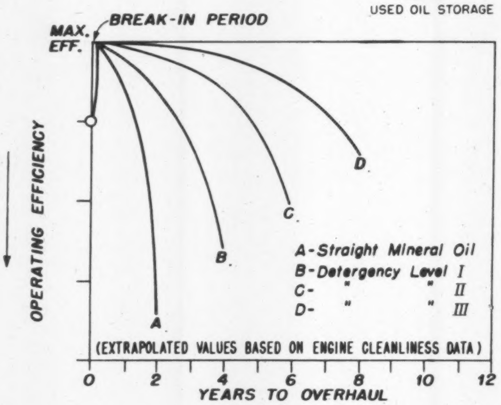
With a good detergent oil the viscosity increase is not likely to exceed 25 per cent in 2000–3000 hr unless the engine is in very poor condition. The pentane insolubles test will generally be below 0.5 per cent. Therefore, after the "used oil" pattern of the engine is studied, the frequency of used oil tests can be reduced.

It should be emphasized that a widely popular method of pumping from the crankcase directly to the lubricator boxes and thus "sweetening" the crankcase oil by adding the new oil to the crankcase does not accomplish the same thing as pumping all of the oil from the crankcase and changing the oil and filters at the same time.

The 2-Cycle Engine

The most pressing lubrication problems of the 2-cycle engine are ring wear, ring sticking, port plugging, and piston-skirt varnish. The test work has shown that the 2-cycle engine performs best on naphthenic detergent-type oils. Engines which have had a long history of port plugging every 60 to 90 days can be made to run for 12–18 months without port plugging by using a naphthenic-detergent oil. In some engines where ring sticking was a severe problem, engines have been made to run for over 2 years without any ring sticking. These tests are being continued. Ring wear has been essentially nil on these engines. Piston-skirt varnish has been eliminated also.

The oil in the crankcase of the 2-cycle engine is apparently contaminated to lesser degrees with the products of oil oxidation and partial combustion. Therefore the crankcase oil in a 2-cycle engine can be made to run for longer periods of time if properly filtered. In some installations the filtered oil from the crankcase is used in the compressor cylinders. In others the crankcase is partially pumped out at set intervals through the filters to a separate storage tank. The oil from this tank is then used in the compressor cylinders. This is a modification of the pump-out system used for the 4-cycle engine.



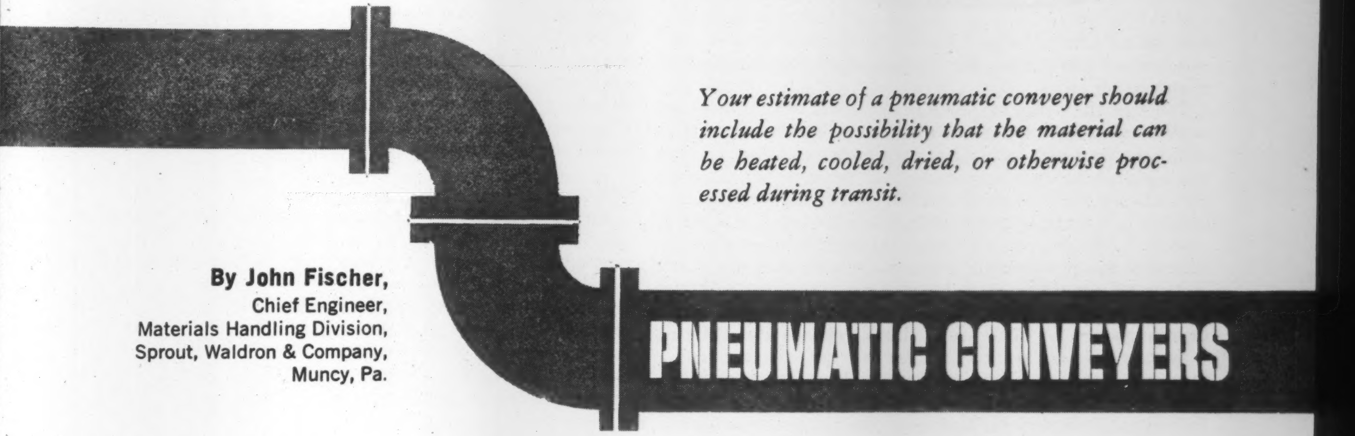
The effect of lubricating-oil quality on engine efficiency. Available data are sufficient for determining relative values.

All of the data accumulated indicate that, where the engine is properly maintained, naphthenic detergent oils increase valve life and spark-plug life. Cases of suspected damage to valves and spark plugs by detergent oils have shown that either the engine was malfunctioning due to causes other than lubrication or that the wrong additive-base stock combinations were being used. Some of the causes of malfunctioning were poor cooling due to fouled water jackets, low crankcase temperatures, poor valve metallurgy, poor valve adjustment, poor spark due to coils or worn magnetos, and poor air cleaning.

Unfamiliar Fields

With the introduction of the newer, higher output, turbocharged engines and the increased use of detergent oils, new problems continue to arise as the gas-engine operators get into unfamiliar fields. Problems of education arising from the use of detergent oils include ash on the piston crowns, on the valves, and on the spark plugs. A carefully planned program will generally show the operators that the small amount of ash appearing in the engine does no harm. A study of the history of valve and spark-plug replacements will generally show that valve life and spark-plug life have been greatly lengthened. Some engines have been running for over 20,000 hr at peak loads on an oil of Detergency Level III without needing valve adjustments and without plug fouling, ample testimony that, with the correct base stock and the correct additives, detergent oils do not cause engine fouling problems.

When the efficiency of the engine versus time is plotted to the date of overhaul, the area under the curve will be greatest for the highly detergent oil drained frequently. These points are illustrated graphically above. Although the available data are not sufficient to establish these relationships on a quantitative basis, they are believed to be correct in relative value and in order of magnitude.



PNEUMATIC CONVEYERS

By John Fischer,
Chief Engineer,
Materials Handling Division,
Sprout, Waldron & Company,
Muncy, Pa.

Your estimate of a pneumatic conveyer should include the possibility that the material can be heated, cooled, dried, or otherwise processed during transit.

Pneumatic conveying is becoming increasingly significant and economically worth while for all free-flowing and relatively dry materials such as powdered and granular chemicals, grain and foodstuffs, plastics, and ores. Among the advantages are flexibility, cleanliness, safety, and ease of automation.

For many applications, pneumatic conveyers have higher capital cost and generally higher horsepower requirements which tend to limit their use. On the other hand, there are many potential uses, supplemental to conveying, which can frequently supply the economic justification for an otherwise costly method of material transfer. Frequently it is also possible to achieve some control over a supplementary function which otherwise would be impractical.

Heat Transfer

The most commonly used secondary purpose of pneumatic conveying systems is heat transfer. Cooling, because of technical difficulties, is less frequently considered than heating or drying.

Heat transfer in a pneumatic conveying system is generally a problem in convection—actually a variation of conduction, because the heat transfer is accomplished by conduction from the fluid medium to the solid particles, although both are in simultaneous parallel movement. To properly understand this, it must be remembered that nearly all pneumatic conveying systems which are used for heat transfer as well as conveying are so-called dilute or low-density systems. The ratio of solids to gas, in consistent units, is relatively low. Conveying velocities are necessarily on the order of 4000 to 6000 fpm to overcome the inertia of the material being conveyed and to keep it in motion. Such velocities usually represent values of Reynolds number ranging from 100,000 to 300,000 which are customarily associated with turbulent flow. Observation, however, indicates that the material, with infrequent exceptions, moves in a laminar pattern. Complete or even partial diffusion of the solids to the fluid state is rarely observed, even with materials having extremely low specific gravity. The material follows a streamline, along the duct wall, where the flow velocity is at its minimum.

What diffusion there is usually occurs at the point where material enters the conveying system. The conveying velocity is still quite high, in spite of the fact that it is considerably lower than the theoretical velocity of the gas stream. For these reasons, such heat transfer as does occur is assumed to be almost instantaneous. The element of time enters in only where the distance to be traversed by the material is of significant proportions.

As already mentioned, conveying velocities of the gas stream range from 4000 to 6000 fpm. It is doubtful if even the lightest materials ever reach more than 80 per cent of the velocity, and heavier materials do not even come close to 80 per cent. Contact time between the gas and the solids is extremely small. Therefore the factor of thermal conductivity is disregarded in establishing a heat balance for preliminary appraisal, and a direct relationship between heat input and output is assumed. This takes the form

$$\text{lb of material per hr} \times \text{sp ht (material)} \times (T_{\text{Mout}} - T_{\text{Min}}) = \text{lb of air per hr} \times \text{sp ht (air)} \times (T_{\text{Ain}} - T_{\text{Aout}})$$

or

$$\text{Btu per hr (material)} = \text{Btu per hr (air)}$$

In establishing this equation it is assumed that the air and material will leave the system at the same temperature. The unknown is usually the number of pounds of air required. Yet, this must be known in order to properly size the system. The equation and the assumptions are extreme generalizations, but they fulfill the purpose for which they are intended. Perfect heat balance and perfect transfer are assumed. A good rule of thumb for practical application of this equation is to

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Contributed by the Process Industries Division and presented at the Semi-Annual Meeting, St. Louis, Mo., June 14–18, 1959, of The American Society of Mechanical Engineers. Paper No. 59—SA-29.

assume an efficiency of 50 per cent for the system; in other words, to double the amount of air obtained by the above formula.

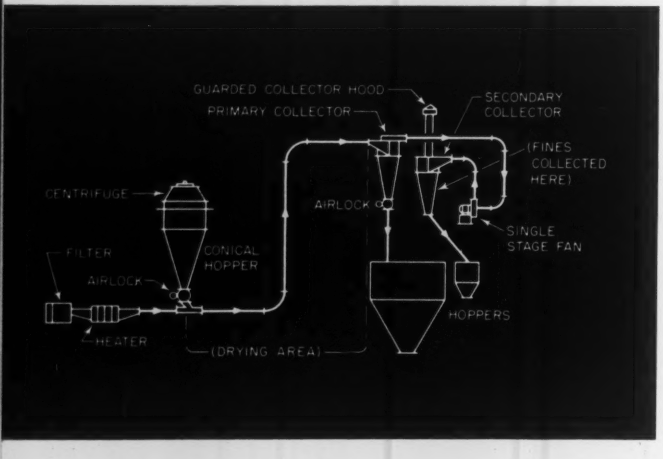
Some of the other important variables which must be evaluated or at least taken into consideration are: particle size, particle shape, and specific heat. Observations have indicated that materials, the bulk of which will pass through a 100-mesh screen, can be effectively and efficiently brought to the desired temperature in a short system. The efficiency of heat transfer in short systems becomes lower as particle size increases, and the joint factors of time and initial conveying-fluid temperature become important. Although additional time of contact is gained by increasing the length of the system, it is only possible to increase the rate of heat transfer by increasing the fluid temperature. This must be considered carefully because the sensitivity of the material to temperature may be such that the temperature differential necessary to obtain the desired results may cause destruction or deterioration of the material. In systems of any length, radiation and conduction losses through the conveying duct will be substantial, and compensation will be required.

Cooling

In a cooling system, the direction of heat flow is reversed. The factors of diffusion, particle size, and specific heat are the same, but considerably more air must be used. For this reason, pneumatic cooling systems have been more difficult to justify economically. If the material contains an appreciable amount of moisture, the control necessary to prevent condensation and fouling of the conveying line often makes cooling impractical. With essentially dry material, the addition of small amounts of moisture to the conveying air facilitates cooling but requires day-to-day and hour-to-hour control based on the variations in atmospheric humidity.

Where negative-pressure systems are used to convey material from hammer mills and other size-reduction units, improved performance and a better product can be obtained by drawing the air for conveying through the processing unit. Screens and breaker parts are kept cleaner, and the smaller particles are cleared away more quickly, allowing effective work to be done where it is most needed. Heat input into the product is reduced, since the air serves to cool the mill. Capacities are increased, and where the negative system is substituted for the usual fan mounted on the mill shaft, the improvement is more than directly proportional to the additional horsepower utilized by the conveying system.

Fig. 1 A heat exchanger tied in with a pneumatic conveying system is used to heat flour at the Chef-Boy-Ar-Dee plant



Drying

Drying is also a heat-transfer operation. Sufficient heat must be provided in the conveying air to vaporize the desired amount of water from the material being dried. The drying of flour, plastics, and bark is among the many interesting applications. Essentially, each of these systems—originally designed on a purely empirical basis—involves flash drying. Where any substantial conveying distance is involved, the factor of equilibrium moisture content comes into very obvious and annoying existence.[1]

Since 1000 Btu are required to evaporate 1 lb of water, in general, the quantity of water to be removed from the material, times the Btu per lb, provides the amount of heat that it is necessary to put into the conveying air. Again, an efficiency of 50 per cent should be used for the heat-transfer system. This is a very broad generalization, which side-steps a tedious and sometimes involved calculation of humidity and equilibrium-moisture content. It is effective for flash drying only and in cases where only partial moisture removal is required.

Total moisture removal is a considerably different proposition. In flash drying, it is possible to use extremely high air temperatures because only free moisture is being removed and the surface temperature of the product never increases very much. Complete or nearly complete moisture removal involves vaporization of bound moisture. Where high temperatures are not possible, particle size, velocity, and capillary action must be considered, and very long systems with relatively low temperatures are required. In the design of such systems, a balance must be established containing not only the heat of vaporization but also sensible heat, convection, and radiation losses, moisture content of the air used for drying, and the estimated equilibrium conditions between the product and the air at the discharge point of the system. Unless constant humidity is provided by a dryer or dehumidifier, it is well to use a substantial factor of safety.

Pneumatic conveying systems used for supplemental heat transfer are generally of the negative type, in which the conveying air is drawn into and through the system by a suction fan. A heating coil is placed across the air inlet to this system. This can be gas-fired, steam, or electrically heated, although the use of an open flame is generally taboo in most process industries. The material is fed into the system through an airlock so that the amount of outside air drawn in is kept to a minimum.

There are many advantages to the use of a negative-pressure pneumatic system. Not the least of these is the fact that all leaks are inward, since it is a vacuum system. Little maintenance is required. The only points requiring any attention at all are the fan-motor bearings and the airlock bearings, both of which, to all intents and purposes, are outside the system itself. The major drawback of such systems is the relatively limited capacity for heat transfer in drying. Because of the relatively low specific heat of the air in contrast to that of most organic materials, a considerable quantity of air is required to effect the desired heat transfer. Systems which can convey 40,000 to 50,000 lb per hr of powdered or granular material can be used effectively to dry only 5000 to 10,000 lb of material, depending on the amount of moisture to be removed. However, the cost and space required to install other types of dryers make these considerations less critical.

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[1] Equilibrium moisture is the limit to which a given material can be dried by a specific medium—that is, a medium at given temperature, humidity, and other conditions.

Positive-pressure conveying systems, in which the motive source is at the inlet end rather than at the discharge end, are not generally used for heat transfer, because the ratio of solids to air which they handle is quite high. Available Btu for the transfer are usually insufficient to cause more than a few degrees temperature rise in the product. However, where extremely long conveying distances and small quantities of product are involved, heat-transfer units have been applied to positive-pressure conveying systems with considerable success. Flour, for example, being transferred from outdoor storage to in-plant use, can be heated from 30 F to the desired 70 F with such a system.

The many variables in the design and operation of any heat-transfer system make pilot-plant tests desirable. These are sometimes conducted by the pneumatic conveying equipment manufacturer.

Size Reduction

Although, to the author's knowledge, no one has ever specifically purchased a pneumatic conveying system for the purpose of size reduction, the potential use of these systems for breaking up material can best be illustrated by outlining the measures taken to prevent it.

Three factors are involved in breakage. They are: conveying velocity, the number of changes of direction, and interior surface irregularities. Each of these results in impact which contributes to breakage.

Since a minimum velocity is needed to keep material in motion, it has been found helpful to increase the line loading as much as possible. This reduces the incidence of random movement of the individual particles, thereby minimizing the effect of the bends. It also reduces the over-all velocity of the moving mass, since a longer period of time is required to bring a large mass to a terminal velocity.

The most effective single factor in breakage has been internal obstruction. Even so slight a factor as misaligned conveying piping can result in unusual amounts of breakage, especially in a lightly loaded system.

Taking all these factors into consideration, it is well within the realm of probability that a pneumatic conveying system can be designed deliberately to increase the percentage of fines in the finished product. The conveying system cannot become an effective substitute for a hammer mill or an attrition mill, but within reasonable limits it can reduce further processing or processing time.

Size Separation

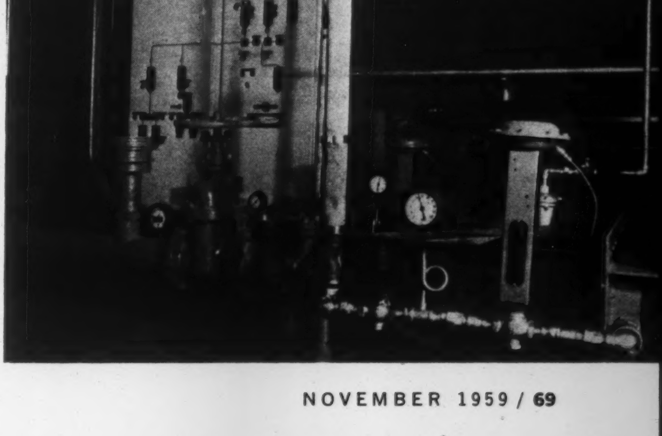
Virtually no separation of particle sizes or of mixtures of particles of different densities takes place in a pneumatic conveying system. Experiments confirming this have been conducted over a wide range of mixtures. However, in a properly designed cyclone collector, an effective degree of separation can be obtained. To understand how this might be accomplished, the vortical principle involved in the separator must be visualized. There are two distinct vortexes in a cyclone. One is a large-diameter descending helix, smaller in diameter, which extends upward to the inner cylinder and the atmosphere. Centrifugal force, which is directly proportional to the square of the stream velocity and inversely proportional to the radius of the cyclone, tends to move the product being conveyed to the outside wall. Actually, two ribbons or strata form: An outer stratum, against the cyclone wall, consisting of material, and an inner stratum consisting of air. For maximum efficiency, the cyclone should be designed so that the path followed by the air and material stream is of sufficient length for virtually complete separation to have occurred when these two streams reach the outlet. As the discharge point is reached, the air stream gradually detaches itself in an effort to escape into the axial low-pressure region of the cyclone. If the downward flow is smooth and unbroken, the material sloping spirally downward will pass out without re-entrainment.

By readily demonstrated analogy, the reverse can be proved. The introduction of a controllable obstruction in the descending section of the cyclone will create a turbulence, casuing re-entrainment of the finer particles into the inner vortex. Placement and design of this obstruction are empirical, requiring a degree of judgment regarding the approximate relative positions of heavy and light materials, and the ribbon of air. In the highly efficient long-cone type of collector used with a negative-pressure conveying system, it is frequently sufficient to provide a controlled leak near the bottom of the collector. Unusually effective separation of unwanted fines has been made by the methods described.

Conclusion

It has been the intent in this paper not so much to discuss in detail the technical and mathematical aspects of the secondary uses of pneumatic conveying systems, but to point out the great potential they have as complementary processing units. It is hoped that further investigation, research, and discussion of these interesting applications will be stimulated.

Fig. 2 Pneumatic system for handling expanded polystyrene with drying and fines separation as attendant benefits



Abstracts and
Comments Based
on Current
Periodicals and
Events

D. FREIDAY
Assistant Editor

BRIEFING THE RECORD

Metal-Like Translucent Ceramic

A POLYCRYSTALLINE ceramic that readily transmits light has been made from powders by the General Electric Research Laboratory. In addition to transmitting light, the new material possesses the extremely high-strength characteristic of alumina ceramics, can withstand much higher temperatures than most ceramics now in use, and can be pressed into any shape desired. No other material, according to the company, combines translucence with this strength, heat resistance, and fabrication ease.

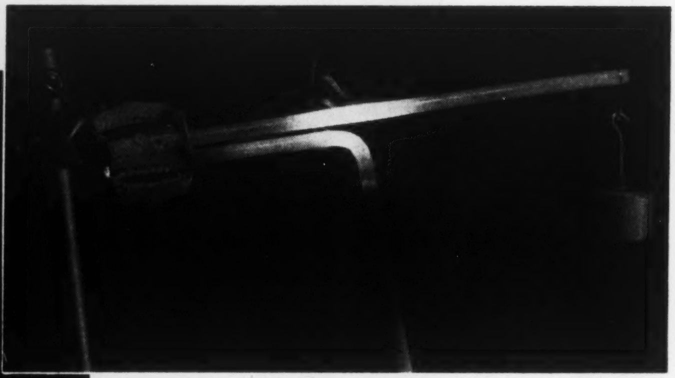
The new material, called "Lucalox," is made from fine-grain, high-purity powdered aluminum oxide pressed at room temperature, then fired at temperatures that are higher than usual for ceramics. It is closely related to sapphire and ruby gem stones, which are single-crystal aluminum oxide, but is superior to these gems in its ability to withstand high temperatures without deforming. Lucalox has the composition of a ceramic, the structure of a metal, and light-transmitting ability approaching that of glass.

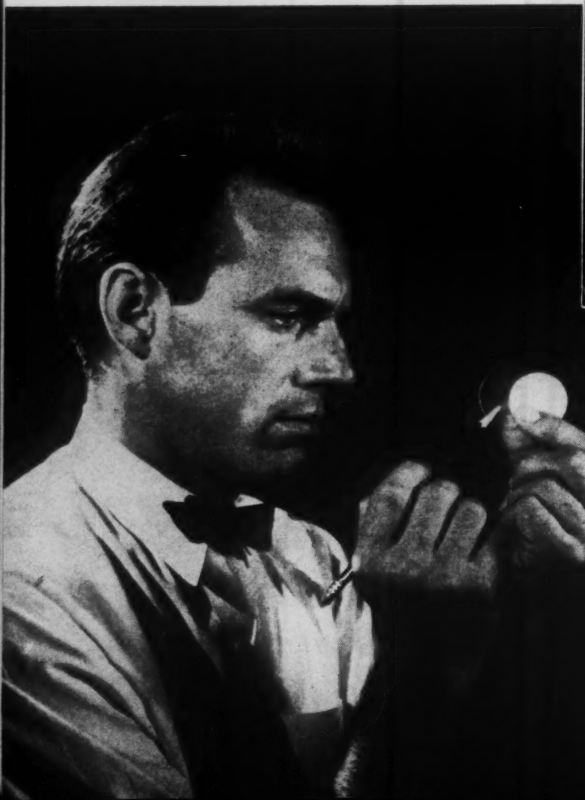
The unique characteristics of Lucalox result from the fact that the microscopically small pores, or "bubbles," that are normally found in ceramic materials have been entirely removed, a feat that had been previously considered impossible.

Because of the elimination of the pores, it is possible to read through a sheet of Lucalox when it is laid flat upon a piece of paper. At greater distances it appears translucent, resembling frosted glass. At least 90 per cent of the light in the visible spectrum is transmitted through the new ceramic.

Lucalox was first made by Robert L. Coble, of the General Electric Research Laboratory. Following his initial research, important contributions were made by P. D. S. St. Pierre, Edward Stover, and Arno Gatti. The problems of making the process commercially feasible are being explored by Charles A. Bruch.

Lucalox, regarded by J. Herbert Hollomon, manager of the General Electric Research Laboratory and Metallurgy and Ceramics Research Department as, "one of the most significant advances in the field of ceramics in hundreds of





Above, when heated to 2350 F by a blow torch, a bar of fused quartz bends under its own weight, while the Lucalox bar easily supports a 50-gram weight at temperatures up to 3200 F.

Left, the transparency of Lucalox is readily apparent when compared with a sample of a conventional ceramic.

Right, pores in a conventional ceramic—the dark spots in the upper photomicrograph—scatter the light, making the material opaque. In the highly dense Lucalox—lower photomicrograph—pores are eliminated and the new material transmits at least 90 per cent of the light in the visible spectrum. Scattering of light at the grain boundaries—dark lines—prevents the material from being completely transparent. The magnification in both photomicrographs is 100×.

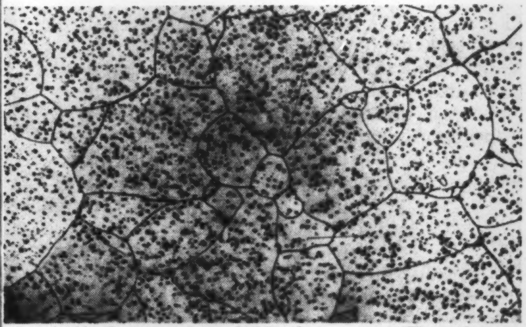
years," resulted from an extensive investigation of the basic principles of the sintering process.

The development of Lucalox, should greatly enlarge the scientific, military, and industrial uses of ceramics. Lucalox should also extend the range of instruments and devices that are presently limited by the physical characteristics of available materials. One example would be high-intensity incandescent and discharge lamps, which are now limited by the heat-resistance of their transparent envelopes, in some cases. Fused quartz, which is often used for high-temperature lamps, performs satisfactorily up to 1800 F. Lucalox is stable at temperatures close to 3600 F.

Another likely application for Lucalox is in the banks of infrared lamps that are used to test the heat-resistance of missile nose cones and other space-vehicle equipment. It may also be used as an electrical insulator and as a material for gem bearings in delicate equipment.

Physical Properties of Lucalox

Optical	
Total light transmission, (visible and infrared), per cent	At least 90
Thermal	
Conductivity, cal per sec-cm-deg C	0.076
Expansion, in. per in. deg C (25–1000 C)	8.6×10^{-6}
Mechanical	
Transverse rupture strength, psi	50,000
Hardness, VPN	1660 to 1930
Electrical	
Resistivity at 500 C, ohm-cm	2×10^{13}
Dielectric strength, volts per mil (at 20 mils)	1700
Dielectric constant, *K*	9.85
Power factor, tan δ	0.00003
Physical	
Density, grams per cu cm	3.98
Crystal structure	Hexagonal/ polycrstalline
Melting point, deg C	2040



Bacon Hydrox Fuel Cell

A RESEARCH GROUP at Cambridge, England, under the direction of a mechanical engineer, F. T. Bacon, who has been engaged in fuel-cell research for over 20 years, has produced the Bacon Hydrox fuel cell with an output of 5 kw (about 7 hp) at 24 volts. According to *Engineering*, August 28, 1959, 10 years of original research were carried out at Cambridge University under the auspices of the Electrical Research Association and the Ministry of Power, prior to 1957 when the National Research Development Corporation placed a development contract with Marshall of Cambridge, an electronics firm.

The Hydrox unit, which operates by a simple reversal of the process of electrolysis of water, consists of forty 10-in-diam cells which have a total output of $2^1/_2$ kw at 32 volts or 5 kw at 24 volts maximum load conditions. To achieve this, a great many technical problems have been solved and automatic controls have been developed.

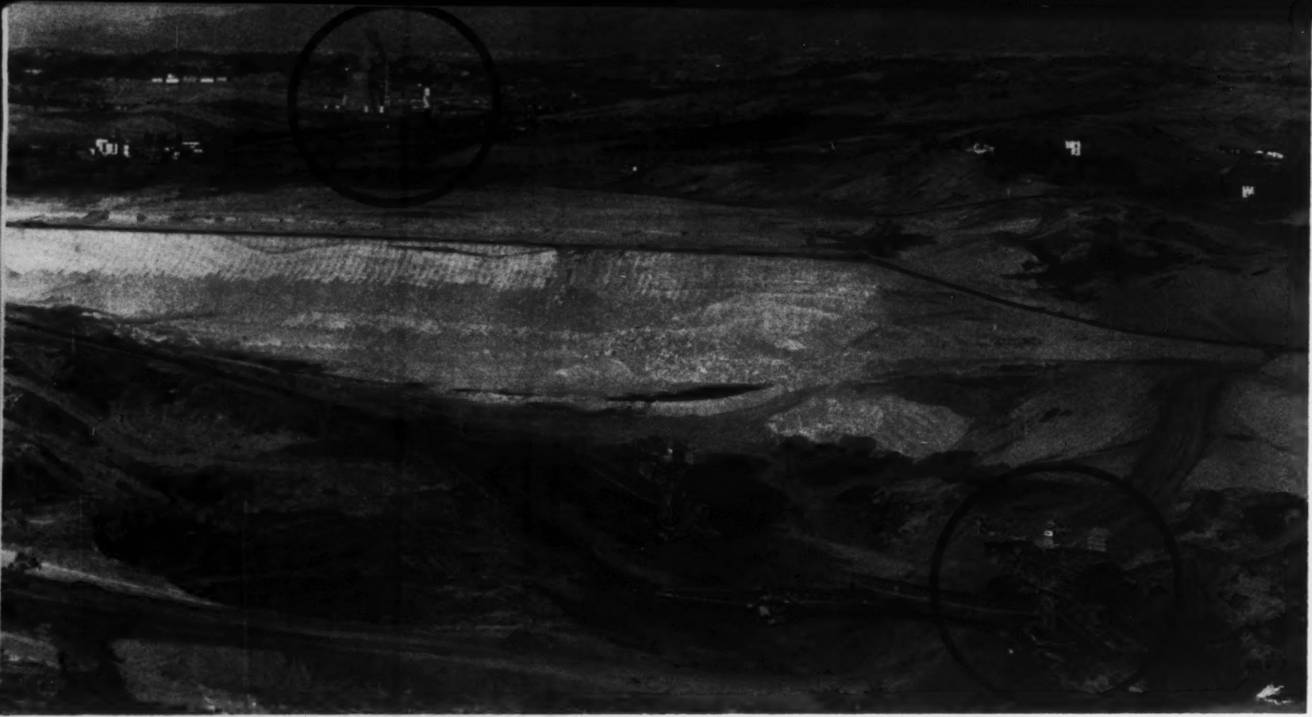
As reported in the *Herald Tribune*, the cell itself is 30 × 15 × 12 in. but with control gear and the heavy tanks for gas storage it is bulky enough to fill a big truck and weighs about 700 lb.

Each of the 40 component cells, according to the article in *Engineering*, consists of two electrodes, one for hydrogen and the other for oxygen, separated by an electrolyte. The electrodes are made of porous and sintered nickel, with a thin layer of a smaller pore size on the liquid side. The oxygen electrode is treated with lithium and preoxidized to prevent corrosion. The electrolyte is strong caustic potash, and working conditions are around 200 C (392 F) and 400 psi. The electrolyte soaks into the sintered metal but, on the application of the gas under pressure from the back of the plate, is expelled from the larger pores only, since the gas cannot bubble through the smaller-pored surface because of the surface tension of the liquid. There is thus a large surface, about 40 sq meters, of wetted sintered metal in contact with gas in each electrode.

Oxygen molecules on the positive electrode combine with water to form negatively charged hydroxyl ions each of which removes an electron from the oxygen electrode. The hydroxyl ions migrate through the electrolyte to the negative electrode where they combine with the hydrogen to form water, depositing an electron in the process. Thus the hydrogen electrode becomes negatively charged with respect to the oxygen electrode and a current flows in the external circuit. To remove the water formed, the hydrogen is circulated past the back of the hydrogen electrodes and the mixture of hydrogen and steam is cooled externally, so that the condensate can be released as required.

Much work has been done on the control system, since the pressure of the two gases must be very evenly balanced if damage is to be avoided. The present system is to keep the oxygen pressure constant and to control the hydrogen pressure against it by an accurate differential-pressure meter, actuating a power-operated inlet valve controlled by a servomechanism. Other problems of initial heating and subsequent cooling also had to be solved.

Advantages of this kind of fuel cell are that it is able to take large overloads at reduced efficiency without damage, it is silent and free from vibration in operation, it has very few moving parts, and the "exhaust" is only water. "Charging," moreover, would merely consist of refilling with the two gases, a rapid process indeed.



The Santa Barbara power plant, **upper circle,** is almost at the edge of an open-pit lignite mine. Excavating machines, **lower circle,** load onto conveyers delivering directly to the plant.

Italian Lignite Power Plant

THE steady increase in demand for electricity and dwindling hydroelectric sites have forced the building of more thermal plants in Italy, and the exploitation of all available sources of fuel.

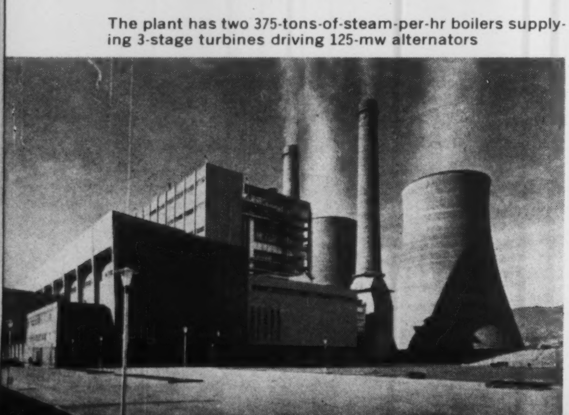
The newest and largest thermal plant in the country is the 250-mw Santa Barbara station, about 25 miles south of Florence. It is located almost on the brink of the partially-developed open-pit lignite mines of Castelnuovo dei Sabbioni and Allori in Valdarno.

Brown Boveri & Company, Ltd., Baden, Switzerland, planned the entire plant and placed the generating units in service only 28 months after receiving the order. Deutsche Babcock & Wilcox, Oberhausen, West Germany, was principal subcontractor, responsible for the boilers and auxiliaries. Brown Boveri at Mannheim drew upon wide experience with lignite plants to supply plans and supervise erection.

The lignite is employed to heat two boilers, each having a capacity of 375 tons of steam per hr. Each boiler supplies a 3-stage steam turbine driving a 125-mw alternator by direct coupling.

The site was selected when it was determined that the stocks of fuel—when mined by modern methods and equipment—were sufficient to keep a large power station running long enough to amortize the original outlay. Huge Krupp excavating machines remove the overburden from the lignite deposit and carry it away from the site. A conveyer-belt system with a capacity of 500 tons per hr carries the fuel to the plant. The lignite is ground down to about 30 mm, and a magnetic separator removes any iron that might be present in the lignite.

The plant has two 375-tons-of-steam-per-hr boilers supplying 3-stage turbines driving 125-mw alternators



Since the quality of the fuel is not classed as high grade, there was no justification for the employment of the extremely high-temperature and pressure-steam conditions that have been applied where coal is used. The pressures and temperatures adopted were 105 kg per sq cm (1493 psi) and 540 C (1004 F).

The article describing the plant in the *Brown Boveri Review* makes no mention of the method of stoking or firing, stating only that ash and slag from the combustion of lignite are continuously collected and blown by compressed air into a silo outside the power-station building. A special ropeway carries the waste materials to the tip.

Hydroelasticity

AS COMBAT SUBMARINES increase their speed, they encounter problems which previously have been peculiar to the aircraft field. Experience gained in fifty years of aerodynamics study may be useful to the naval architect and marine engineer in dealing with the problems of hydroelasticity.

Hydroelasticity is in many ways the marine counterpart of aeroelasticity which has been defined as the phenomenon involving interactions among inertial, aerodynamic, and elastic forces. H. N. Abramson, Mem. ASME, an authority on the dynamics of airplanes, is director of a Navy-sponsored research project at Southwest Research Institute. He is coauthor with Comdr. S. R. Heller, Jr., USN, of an unclassified paper outlining some of the boundaries of this new field.

Among the problems of the first supersonic aircraft were those which resulted from divergence and flutter. The elasticity of the lifting or control surfaces would result in instability which might tear the airplane to pieces.

Mechanical vibration, in which a part of the airplane moves periodically, has its exact counterpart in submarine design. However, ship vibration (which can cause serious limitations on speed) is of increased concern because of the mass of the fluid which is set in motion, as contrasted to the relatively smaller amounts of air affected in the case of the airplane. Another concern is structure-borne noise which results from the mechanical vibration. These sounds radiate through the hull and would permit easy detection.

Impact in aircraft refers to a rapidly applied and removed external load. Iis counterpart for ships is grounding, collision, or enemy attack.

When the submarine is surfaced, the naval architect must also be concerned with a vehicle which is operating in two fluid media, in contrast to the aircraft which operates in only one. Such considerations as wave impact, water entry, and slamming must be considered. Water-entry-type problems may be encountered when such new fast submarines come out of the water after a steep climb. They return with a resounding smack. When a ship progressing into a regular pattern of waves periodically attains the proper phase relationship between the downward motion of its bow and the crest of an oncoming wave a similar phenomenon exists. This results in the creation of a violent impact between the structure and the water. This action is called slamming.

Towing and mooring are other problems which must be considered. Hydrodynamic impulses at one end of the cable cause transient stresses in the cable.

These various facets of the problem have been linked together as hydroelasticity, a new area of investigation concerned with the elastic deformations of structure which induce additional hydrodynamic forces.

New Vacuum-Melting Furnace

A PROCESS has been developed which produces the purest steel available according to the American Bridge Division of U. S. Steel Corporation. A full-scale, pilot consumable-electrode vacuum-melting furnace, the largest of its kind ever installed, was designed and built primarily for melting ferrous metals. Allis-Chalmers supplier of the electrical equipment, was an active participant in the development.

In this process, the metal to be melted is first formed into a long, rod-shaped electrode and is gradually melted in a vacuum. Through the remelting process, certain impurities in the steel are eliminated and a stronger steel produced.

Capable of producing up to 32-in. round ingots weighing 20,500 lb, the new furnace can produce bearing steels, high-temperature stainless steels, ultrahigh-strength alloy steels for missiles and aircraft, rotor, and other special steels.

This method yields steels with much lower hydrogen, oxygen, and nitrogen gas content; improved hot workability and cleanliness; and comparative freedom from center porosity and segregation.

Power is supplied by an Allis-Chalmers 1700-kva, three-phase, dry-type transformer with three large saturable reactors for power control. The transformer is designed for 80-C temperature rise and is equipped with forced air-to-water heat exchangers for cooling.

A magnetic-amplifier-type furnace regulator and m-g set run a motor to lower the electrode as it is burned away. Constant arc voltage is maintained in this way.

Taps in the primary allow extremely large power-output-control range from 15 to 60 volts at 20,000-amp d-c. The three single-phase saturable reactors are connected in series with the primary to give stepless current control over d-c power loads.

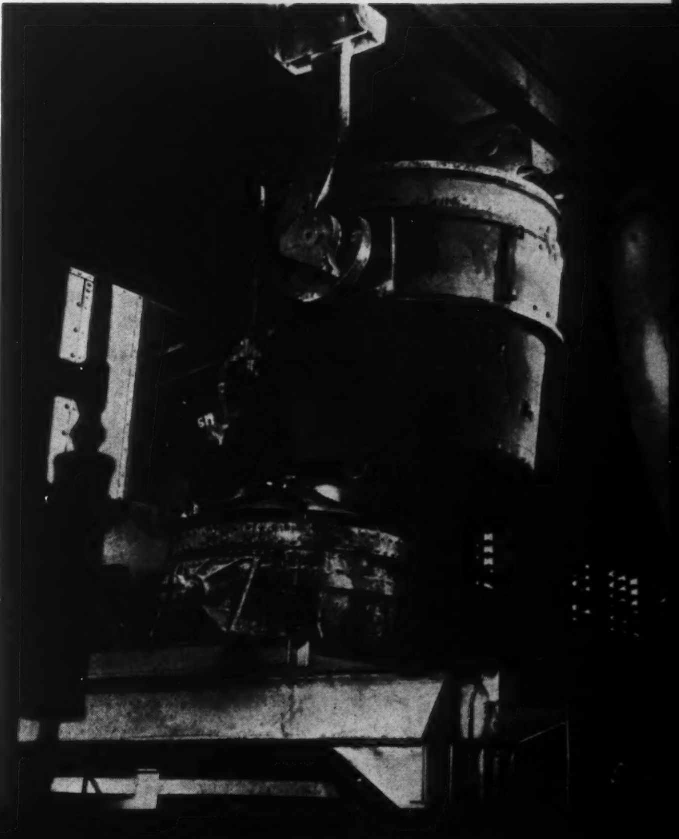
Four separate semiconductor germanium-rectifier cubicles are fed by the transformer. They are rated at 5000-amp, d-c, 80 volts, no load.

A thermostat, water-flow and air-flow switch, and a blower-motor overload element protect the equipment. In addition, the germanium cells are protected by high-speed, current-limiting-type fuses.

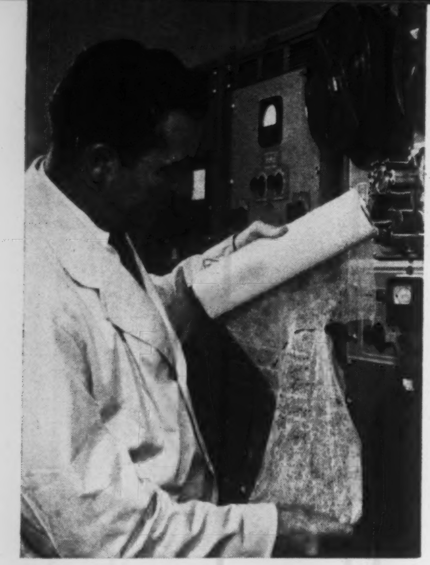
The electrode voltage-regulation equipment provided gives extremely accurate voltage regulation for the very slow rate of electrode travel. Melting sufficient electrode material to provide a 7-ft ingot requires 6 to 7 hr.

The furnace consists of two sections. The upper section is a water-cooled tank (above ground level) that houses the electrode, and the lower section (below ground level) is a water-cooled copper mold in which the melting takes place. The electrode is connected to one terminal of a high-amperage, low-voltage power source, while the mold is attached to the opposite terminal.

Steam-ejector pumps first evacuate the furnace to a near-perfect vacuum of approximately 5 micron Hg abs. When the power is turned on, molten metal is transferred across the arc and deposited in the mold while the electrode descends and is consumed. Temperature at the arc region is about 6000 F. Solidification takes place almost immediately and the ingot is formed. A remote optical-viewing system gives the furnace operator a periscopic, continuous view of the arc.



Generator-rotor-forging ingots up to 32 in. in diam and weighing 20,500 lb are produced at U. S. Steel's Duquesne Works with a new consumable-electrode vacuum-melting furnace. It can produce bearing steels, high-temperature stainless, and ultrahigh-strength alloy steels.



Scratch-free industrial dusting fabric can be torn easily from perforated rolls. It is also useful as a porous protective cover.

Ordinary woodworking tools cut smoothly through the new Babcock & Wilcox Insulating Firebrick; eliminating the need for costly special shapes.

Materials Briefs

▶ Industrial Dusters

A NONWOVEN, scratch-free fabric designed to pick up and hold dust has been introduced by the Industrial Trades Tape Division of Minnesota Mining and Manufacturing Company, St. Paul, Minn.

Called "Scotch" brand dusting fabric No. 550, this exceptionally thin material—neither a cloth nor a paper—can collect dust from even the most detailed precision instruments, electronic equipment, cabinets, and similar locales. It will also provide a porous protective cover over objects requiring ventilation while stored.

The rayon-type material, can be used several times without losing its effectiveness. Thousands of dust-collecting pockets are formed by extra-long rayon fibers, bound together with a synthetic, odorless, unifying resin. Since it is not woven, there are no loose fibers or edges to unravel.

Although its unifying resin attracts and holds the dust, the fabric is not oily or sticky and has no silicones or corrosive chemicals which could remain as film residue.

The dusters, test marketed for more than two years, are said to be softer than many facial tissues and will be supplied in 12-in-wide × 30-yd-long rolls.

▶ Improved Insulating Firebrick

An insulating firebrick that is stated to be both the lightest in weight and the lowest in thermal conductivity of any available in the 2300-F use-limit range has been placed on the market by the Refractories Division of the Babcock & Wilcox Company.

The mechanical strength of the refractory has been increased by more than 65 per cent in the K-20 form and by more than 50 per cent in K-23. It can be fitted with hangers or pins without danger of breakage.

The K-20 has an average weight of only 1.70 lb per 9-in. straight. The K-23 9-in. straight averages 1.85 lb.

Better mortar bonding and resistance to gas erosion are other important features. Superior resistance to direct flame exposure enables the insulating firebrick to withstand the erosive effects of circulating gases and flame impingement.

The B & W Insulating Firebrick can be tailor-cut, drilled, or shaped with ordinary woodworking tools.

▶ TRC-X Phenolic Laminate for 1000-F Service

A new plastic material, designated TRC-X phenolic laminate, has been developed by Riverside Plastics Corporation, Hicksville, N. Y., to meet the need for a low-dielectric, structurally strong material in the 1000-F

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Nuclear Briefs

▶ India Plans 250-emw Nuclear Power Plant

A NUCLEAR power plant to be located between the west-coast seaport of Bombay and the northern inland city of Ahmedabad is to be built in India by 1964, according to the *Forum Memo* published by the Atomic Industrial Forum, Inc. The 250-emw plant of undisclosed type would contribute power to the grids of both cities, which by 1964 are expected to have installed capacities of 900 emw and 200 emw of conventional power. The site would be made large enough to accommodate a possible second unit of 250 emw. Bids from foreign manufacturers will be invited later this year, with construction due to begin in 1961.

▶ Natural-Circulation Pressurized-Water Reactor

Design, development, and prototype construction of an $18.5-million natural-circulation, pressurized-water-reactor plant for naval ship application has been assigned by the AEC to the Knolls Atomic Power Laboratory at Schenectady, N. Y., operated for the AEC by the General Electric Company.

The natural-circulation-reactor plant offers promise of an improvement in the field of pressurized-water reactors for naval ship propulsion through plant simplification and increased operating reliability. This reactor concept eliminates the need for large circulating pumps and associated electrical generating and control equipment by using natural convection to circulate the reactor cooling water.

range. It is the first material of its type consistently to withstand higher temperatures and instantaneous thermal shock and yet retain good structural properties. When room-temperature TRC-X is suddenly subjected to 1000 F it does not blister or delaminate.

The material's structural integrity at elevated temperatures is such that it has replaced metal parts for missile components where skin temperature often rises to 900 F due to air friction. It is used for missile bodies, nose cones, fins, and radomes. High-performance aircraft can also utilize TRC-X in leading edges of wings, control surfaces, and other parts.

TRC-X laminate is also used as a heat-insulation barrier. When bonded to aluminum, for example, its low thermal conductivity prevents high skin-friction temperatures from annealing the metal underbody. Consequently, the aluminum structure retains its strength.

▶ Columbium, Tantalum, Vanadium Tubing

Columbium, tantalum, and vanadium—three metals from the reactive group—are now supplied commercially in small tubing form by Superior Tube Company, Norristown, Pa.

Superior classifies columbium, tantalum, and vanadium tubing as special analysis tubing; that is, the raw material is not normally carried in stock but is ordered against customer orders. The tubing is furnished in the seamless grade and in the fully annealed, half-hard-drawn, and full-hard, as well as in intermediate tempers, in sizes from 0.012 to 1.125-in. OD.

▶ Teflon Film to Be Marketed

The extraordinary properties of Teflon fluorocarbon resins will be available commercially late this year in the form of thermoplastic film from du Pont's Film Department. Teflon FEP-fluorocarbon film will be the fifth and newest member of du Pont's family of films for industrial and packaging uses. It will be produced in pinhole-free films in gages ranging from $^1/_2$ to 40 mils and over.

The film has outstanding heat and chemical resistance, excellent electrical characteristics, and other properties particularly useful in industrial applications. It is heat-sealable, heat-formable, vacuum-formable, can be metalized, and in many instances can be bonded to other materials without adhesives.

Largest immediate market area for the film is expected to be in the electrical and electronic fields. Outstanding electrical insulating characteristics retained over wide ranges of both temperature and frequency permit the use of very thin sections as an effective insulating material.

The film is inert to virtually all known chemicals and solvents at temperatures up to 400 F. It has no known solvent and is affected only by alkali metals and certain complex halogenated compounds at elevated temperatures.

Resistance of the film to degradation by weathering is exceptional and testing to date indicates that its outdoor life is virtually unlimited.

Other properties of the film include its toughness and strength, which are retained over a wide temperature range, lack of moisture absorption, and low permeability to liquids, gases, moisture, and organic vapors.

▶ Plastic Glue for Damaged Bones

A plastic glue designed to repair damaged bones and put a patient back on his feet in 48 hr is under development by the Army Medical Service. The treatment is termed "experimental" at this time.

A polyurethane foam is used which solidifies into a porous, rigid substance when applied to a fracture, bonding the bones together until bone cells grow through the material. Over a period of several months the body completely replaces the plastic with natural bone.

The plastic is applied by opening the fracture site and packing the polyurethane around the broken or diseased bones. In addition to "glueing" broken bones, the substance can be used to replace fragments of damaged bone. It is molded by the surgeon to match the original bone contours.

The foam has no immediate toxic effects, but its long-range effects on the body are not yet fully understood. Army researchers are now engaged in "tagging" the polyurethane with a radioactive isotope "tracer" in order to learn what happens as it disappears from the fracture site.

The length of hospitalization for wounded soldiers may be greatly reduced by the use of the plastic. It would be particularly important to the Army since 60 per cent of combat casulaties suffer bone fractures.

The plastic has been extensively evaluated by Captain Joseph Salvatore at the Department of Experimental Surgery, Walter Reed Army Institute of Research, Washington, D. C. Salvatore, prior to entering active duty and Michael Mandarino, an orthopedic surgeon at Hahnemann Medical College and Hospital. Philadelphia, Pa., first applied the foam substance to bone mending several years ago.

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▶ Small Demonstration Pressurized-Water Plant

Gibbs and Hill, Inc., of New York, N. Y., has been selected to provide conceptual design services for a small pressurized-water nuclear power plant planned by the Atomic Energy Commission. The contract includes an option for detailed design of the nuclear portion, excluding equipment design of the reactor. The reactor will be procured separately.

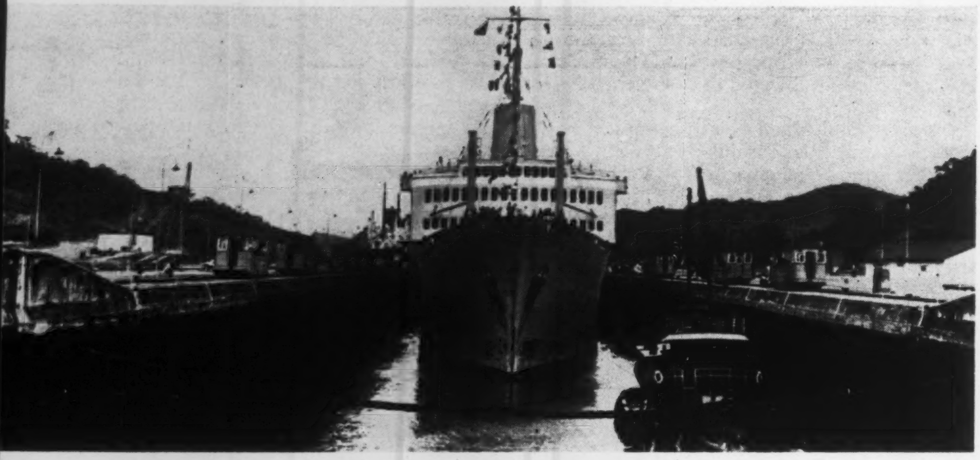
The proposed plant will be designed to produce 16,500 ekw. With installation of an optional conventional superheater, capacity could be increased to 22,000 ekw. Proposals for participation by co-operatives and public-power organizations have been invited. The major objective will be to provide a significant contribution to the achievement of economical electric power in a small plant.

▶ Boiling-Sulfur Reactor Coolant

Aerojet-General Nucleonics, a subsidiary of Aerojet-General Corporation, has started work under an AEC contract to investigate the feasibility of using boiling sulfur as reactor coolant with graphite as moderator. Such a system has a potential thermal efficiency of 50 per cent—which is about double that of present nuclear power plants.

This would not only result in a decrease in fuel cost, but a more efficient plant could operate at lower reactor power for the same electrical output, which might lead to savings in the plant cost.

The sulfur-handling experience, evolved over many years in the oil and chemical industries, will form a guide for this new application.



S. S. Gripsholm approaches a fender chain which keeps runaway vessels from damaging lock gates on the Panama Canal. Hydraulic system using De Laval centrifugal pumps pays out the 15-ton fender chain at a constant tension of 100 gross tons to provide braking action.

Canal-Lock Protection

Stopping 60,000-ton ships within 70 ft is the capability of a hydraulically snubbed chain system that protects Panama Canal lock gates against runaways. Centrifugal pumps weighing less than 4000 lb maintain the hydraulic pressure which enables chain barriers to stop huge ships before they can reach lock gates. The Panama Canal Company has recently installed 36 of the 100-hp-motor-driven pumps, made by De Laval Steam Turbine Company, Trenton, N. J.

The 15-ton chains are stretched across the locks in case the Canal's famous "mechanical mules" lose their towlines to a ship. If the mules can't stop a ship after it has moved into a lock, the ship strikes a chain across the lock and is snubbed to a stop. The chains are connected to a hydraulic system which maintains a constant tension of 100 tons, which slowly but surely brings the ship to a stop short of the gates. The slow steady snubbing action prevents the chains being strained beyond their breaking point, and avoids damage to the ship's bow.

The 100-ton tension enables a ship of 5000 gross displacement tons, moving at 5.5 knots, to be stopped within 70 ft. A 10,000-ton ship moving at 3.8 knots, or a 60,000-ton ship moving at 1.2 knots, can be stopped in the same distance. To maintain the pressure, the De Laval pumps are each capable of delivering 555 gal per min against a pressure of 150 psi.

Automatic controls drop a chain to the bottom of the lock whenever the gates which the chain protects are open. When the gates close, the chain automatically returns to position across the lock. Locks are filled or emptied in about 8 min. To be certain that chains are ready when needed, the hydraulic system positions a chain in 6 min.

The electrically driven De Laval pumps were installed recently when the Panama Canal Company changed from a 25 to a 60-cycle electrical system. The two-stage pumps have impellers back-to-back to neutralize hydraulic thrust. Horizontally split casings of Meehanite were supplied to provide ease of access and trouble-free life.

Gage-Block Calibration

The National Bureau of Standards, NBS, has been able to certify the accuracy of length measurements made on two commercial gage blocks to better than 1 part in five million.

The measurements described at the 14th Annual Instrument-Automation Conference and Exhibit of the Instrument Society of America were made on a 16-in. and an 18-in. gage block, both sent to NBS by the Moore Special Tool Company. Each gage block was converted into a line standard by wringing a graduated gage block to each end. This was then compared with the working standards of the United States—bars with carefully engraved lines marking the standard distances. This part of the calibration was performed in the NBS length laboratory.

The blocks were then measured in terms of wavelengths of light in the NBS engineering metrology laboratory. The results obtained by the two methods agreed to the nearest millionth of an inch or better for both gage blocks. This not only "proves" the accuracy which can be obtained in gage-block measurements, but it also serves to verify the accuracy of the wavelengths of various light waves as expressed in terms of the international meter bar. The NBS measurements also agreed to 2 microin. with independent measurements made by the National Physical Laboratory, Teddington, England, on the same blocks.

Improved accuracy of NBS calibrations in this field is the aim of a special research project sponsored jointly by NBS and a group of leading manufacturers and users of gage blocks. The goal of this program is to provide the basis for a regular NBS gage-block calibration service with certified accuracies of 1 part in ten million or better. The present routine accuracy of gage-block calibration is 2 parts in a million.

Nuclear Power Costs

A series of design and engineering studies has been made for the Atomic Energy Commission to determine the cost of nuclear power generation by heavy-water, pressurized-water, boiling-water, and organic-cooled reactors, HWR, PWR, BWR, and OCR. The studies were made for a reactor of the size judged to be most economical, for uniform site locations and modes of operation, and with uniform costing bases, for which construction could be started in July, 1960.

As reported in the September, 1959, issue of the quarterly, *Power Reactor Technology*, prepared for the AEC by

Comparison of Electric Generating Costs, in Mills per Kwhr[a]

	Conventional plant[b]	PWR	BWR	OCR	HWR
Net electrical output, mw	306	236	306	300	221
Fixed charges (14 per cent 80 per cent capacity)...	3.67	5.1	5.4	4.7	6.4
Heavy-water inventory (12.5 per cent per yr)...	...	...	...	...	1.5
Fuel-cycle costs..........	3.31	2.7–3.1[c]	2.8–3.3[c]	2.5–3.0[c]	2.0–3.0[d]
Operation and maintenance.................	0.37	0.5	0.5	0.5	0.7
Organic or heavy-water make-up..............	...	...	...	0.6	0.2[e]
Total power cost[f].......	7.4	8.3–8.7	8.7–9.2	8.3–8.8	10.8–11.8
Total power costs for comparable - sized modern coal-fired unit[g]	...	7.1	7.4	6.9	...

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[a] Costs adjusted for full-power operation in January, 1964, with construction starting in July, 1960.

[b] Breakdown of BWR contractor estimates.

[c] Burn-up of 13,000 to 10,000 mwd/ton.

[d] Burn-up of 7500 to 5000 mwd/ton.

[e] There is no operational experience on which to predict the heavy-water losses for power reactors.

[f] The relative likelihood of achieving these costs is reflected by the proposed research and development costs of $8.6, $2.9, $8.4, and $10.7 million for the PWR, BWR, OCR, and HWR, respectively. If these costs were written off for the first plants, they would increase the power costs 0.7, 0.2, 0.6, and 1.1 mills/kwhr, respectively.

[g] Estimate made by each contractor using same site data and general assumptions as for the nuclear unit. Fuel costs are assumed to be 35 cents per million Btu.

General Nuclear Engineering Corporation, none of the nuclear power plants studied is likely to be competitive with conventional units of the same capacity in any area of the United States at the date proposed for construction. "A cost differential of 1 mill per kwhr or more is probable."

"There is no major difference in the cost of power to be expected among the PWR, BWR, or OCR as designed. The apparent slight cost advantage of the PWR when normalized to 300 emw needs careful scrutiny in view of the magnitude of research and development required to confirm the design, and in view of the uncertainty of technical feasibility of the larger size.

"The estimated cost of power from the HWR is at least 1 mill per kwhr more than the other three systems. The use of enriched uranium in this reactor, which was designed to be operable on natural uranium, would reduce costs only a few tenths of 1 mill per kwhr."

The HWR studies were carried out by Sargent and Lundy, assisted by Nuclear Development Corporation of America; PWR studies by Stone and Webster Engineering Corporation, assisted by Combustion Engineering, Inc.; BWR studies by Ebasco Services, Inc., assisted by the General Electric Company; and OCR studies by the Bechtel Corporation assisted by Atomics International.

Explosion Forming with Electricity

STORING up electrical energy and then releasing it within 40 millionths sec with a force equal to 6000 hp is being used experimentally for certain metal-forming operations that normally employ conventional motor-operated hydraulic-press equipment.

Republic Aviation Corporation, Farmingdale, N. Y., is developing the method as a potential solution to the problem of working with high-strength metals used in the production of advanced aircraft and spacecraft. Some of the newer steel and titanium alloys and other exotic materials have practically no "stretchability," and require complicated equipment of tremendous force to shape them to the close tolerances and aerodynamic smoothness needed. High-pressure "explosive forming" appears to be a method of obtaining this magnitude of force from simple and inexpensive equipment, employing the "shock-wave" power created by a lightning-like flash of electricity.

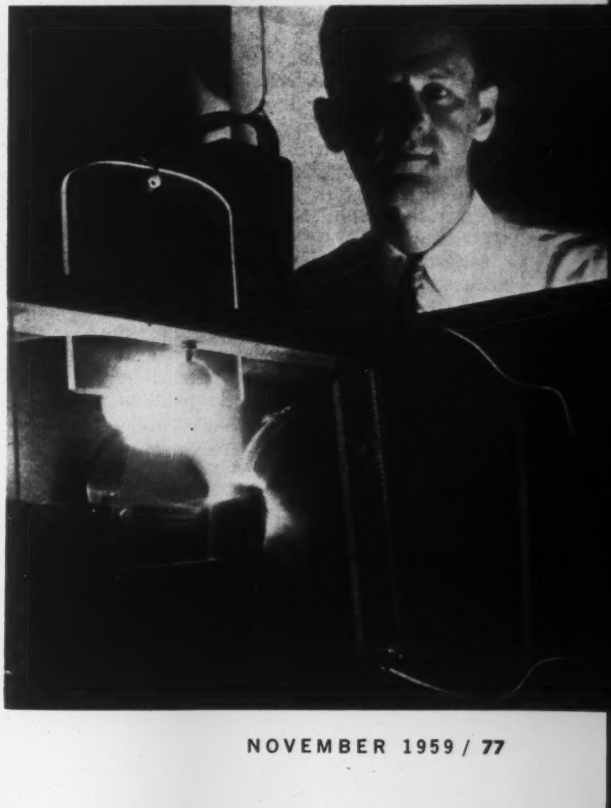
The device's detonator is a high-voltage spark. Electric power is fed into a battery of capacitors. Wires from the plus and minus terminals of the capacitors are attached to two electrodes immersed in water. When a discharge switch is released, the "explosion" occurs, complete with lightning flash and thunderclap. The resulting spark travels through the water at extremely high velocity, creating a shock wave. It is this shock wave that actually does the forming work.

Although engineers have speeded up the spark bomb's release time to 40 millionths sec they hope to reduce the time factor even more as experiments continue and to obtain still greater horsepower.

The explosion technique is already being used in certain forming operations which involve conventional blasting materials such as dynamite and other high-explosive compounds. However, these have disadvantages with respect to safety and it is difficult to maintain precise control over the energy created.

The company is working toward eventual development of the device as a standard machine tool which would cost about $50,000 and replace conventional hydraulic presses that run about half a million dollars apiece. The device would require only a fraction of the floor space needed for the presses.

A flash of artificial lightning triggers an underwater explosion that bulges an aluminum tube with a force of 6000 hp. It is being used experimentally for certain metal-forming operations that normally employ motor-operated hydraulic presses.



Corrosion Research at NBS

Corrosion is a complex process which has been defined as the destruction of a metal by chemical or electrochemical reactions with its environment; and deterioration often proceeds in direct proportion to the aggressiveness of the environment. Essentially, corrosion is process metallurgy in reverse. Iron, for example, occurs in nature generally as oxides or hydroxide, and is refined to the steels of structural use. When exposed to a corrosive environment, the metal tends to revert to these original forms.

Corrosion is a serious and costly problem. Depletion of ore reserves, labor cost, equipment down time, and replacement costs all enter into the estimated billions of dollars which corrosion costs annually in the United States. Although exact figures are impossible, reliable estimates show that the expense of replacement in the underground-pipeline industry alone runs to about $600 million a year.

The NBS Program. The National Bureau of Standards, NBS, has had a continuing program of research for many years which emphasizes basic processes and principles, seeking to discover why metals corrode and how corrosion can be prevented. Some of the details of this work and a number of references to the published results are contained in Summary Technical Report STR-2370, available from the NBS Office of Technical Information, Washington 25, D. C.

Current studies deal with such topics as the corrosion reactions at the metal surface, electrochemical polarization and other electrical phenomena associated with corrosion, the effects of free radicals on metals at low temperatures, the nature of corrosion in large single crystals, and the mechanism of stress-corrosion cracking. By attacking the problem from these various directions, NBS hopes not only to improve methods of combating corrosion, but also to obtain basic data on the properties of matter that may be useful in other fields.

One of the first corrosion studies at NBS was on the "season cracking" of brass, a form of stress corrosion that affects the grain boundaries in a selective manner. Other investigations have explored the electrolytic corrosion of steel by stray electric currents, underground corrosion from soil,[1] and (under the sponsorship of the Navy's Bureau of Aeronautics) the corrosion of aircraft alloys.

Single-Crystal Studies. As the corrosive process is influenced by many factors, a study of metals in their commercially usable state affords little information on the fundamental nature of the process. Such information can best be derived by studying the least complex form of the metal that has the basic characteristics of the whole, that is, metal in the form of single crystals. These studies under the sponsorship of the Corrosion Research Council seek to isolate the corrosion-influencing factors of polycrystalline materials and to obtain reproducible results.

Galvanic Corrosion. Even the purest metals have many foreign atoms within their lattices. Less pure metals contain nonmetallic inclusions, metallic impurities, and other inhomogeneities. Exposure to a corrosive medium of dissimilar metals in contact with each other, or of a metal with surface inhomogeneities causes galvanic (electrochemical) corrosion. Such corrosion can also occur on metal surfaces exposed to nonuniform electrolytes with variations in electrical conductivity and by other means.

The electrical current associated with corrosive action causes the metallic area with the more anodic solution potential to dissolve, forming a pit in the metal surface. The depth of pitting depends on the amount of current that flows from anode to cathode, which in turn may depend on several factors such as anode-to-cathode area, environment, temperature, and pressure. When the mechanism that causes the first pit to form can be determined, a great advance will have been made in understanding the corrosion process.

In a part of this work it was found that steel exposed to soil environments varying in pH between 2.9 and 9.6 can be protected from corrosion by maintaining the steel at an electrical potential of −0.77 volt relative to a saturated calomel reference cell. Recent laboratory experiments showed that −0.77 volt is also the optimum potential for protecting steel in salt water.

Stress Corrosion. The crystal structure of metals has a direct bearing on stress-corrosion cracking, a particularly damaging type of failure resulting, as its name suggests, from the combined effects of stress and corrosion. Cracking may be either intercrystalline, as in aluminum alloys and low-carbon steels, or transcrystalline, as in magnesium alloys and stainless steels. Of particular interest are the copper-zinc alloys, in which the attack is intercrystalline in the alpha phase and transcrystalline in the beta phase.

Residual or applied tensile stresses—frequently far below the yield strength of the material—may produce this type of failure even though the corrosive effect itself is very mild. Specific environments are often required, but in some cases a number of different media may cause cracking. Most investigators agree that practically all metals and alloys are subject to this failure when the necessary combination of stress and corrosion is present.

When most metals are exposed to ordinary atmospheres, a thin oxide covering quickly forms that tends to protect the metal from further corrosion. Stress-corrosion cracking apparently starts with a scratch or break in the protecting film. In investigating this type of cracking in several metals, NBS found that the process usually is continuous to complete failure. However, if shifts in stress concentrations permit repair of the film from time to time, the process may be discontinuous.

Future Work. In the near future, the NBS expects to investigate corrosion inhibitors of the precipitate or barrier type. This work will explore the kinetics and energy associated with the formation of the precipitate, and the forces binding it to a metal surface. Additional corrodents will be studied in the work on aluminum single crystals, and single-crystal research will be extended to other high-purity metals.

A specimen in which most of the variables can be controlled has been devised for future stress-corrosion studies. Investigations have been started on the influence of temperature and high pressures on the mechanism and kinetics of metal oxidation, as well as additional work on the reactions between atomic oxygen and metallic surfaces. The results of these and related studies are expected to provide science and industry with solutions to some of the practical corrosion problems that are causing concern today.

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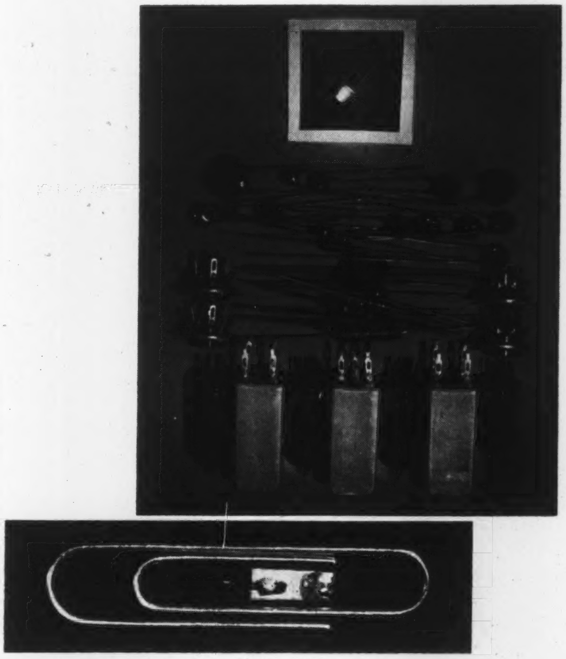
[1] More than 300 reports containing information gained during this effort have been summarized and published as NBS Circular C-579, "Underground Corrosion."



All of the conventional components illustrated from an FM receiver could be eliminated with the tiny encapsulated tunnel diode, **inset,** whose contents are compared in size with a paper clip, **lower photo.**

The "Tunnel Diode"

THE "tunnel diode," newest member of the fast-growing family of electronic devices, is coming of age as a result of an intensive company-financed research program at General Electric.

First reported in 1958 by Japanese scientist Leo Esaki, the device is first cousin to a transistor, but operates on a different principle and offers advantages that the transistor does not. It takes its name from the physical phenomenon that makes it possible—"quantum-mechanical tunneling." This is a process whereby a particle (obeying the laws of the quantum theory) can disappear from one side of a potential barrier and appear instantaneously on the other side, even though it does not have enough energy to surmount the barrier. It is as though the particle could "tunnel" underneath.

In the tunnel diode, this barrier is made extremely thin (less than a millionth of an inch). Penetration of the barrier gives rise to an additional current in the diode at very small forward bias which disappears when the bias is increased. It is this additional current, called the Esaki current, that produces the negative resistance in a tunnel diode.

Negative resistance means that an increase in the voltage can result in a decrease in the current. Instead of absorbing the signal, as a resistor does, the diode increases it permitting it to act as an amplifier and perform many other functions.

In the field of communication, tunnel diodes compete with transistors, parametric amplifiers, vacuum triodes, magnetrons, klystrons, traveling-wave tubes, and masers. The pertinent characteristics for comparison in this field are maximum oscillation frequency, minimum power requirements, and low noise amplification.

In computer applications the tunnel diode competes with transistors. It is at least 100 times faster than today's transistors, and can be made to use only about $^1/_{100}$ as much power. Moreover, it is insensitive to temperature changes.

Because it is less dependent on the structural perfection of its crystal than the transistor, it is much less affected by nuclear-radiation damage, out-ranking transistors by more than 1000 to 1. Semiconductors that have been used in making tunnel diodes include silicon, germanium, gallium arsenide, gallium antimonide, and indium antimonide.

The tunnel diode is smaller than a transistor and, because of a simpler structure, ultimately will be a small fraction of its present size. It also is little affected by environmental conditions. Silicon tunnel diodes will work at 650 F; compared with a 400-F limit for conventional silicon diodes.

To spur progress in circuit design, General Electric's Semiconductor Products Department plans to offer limited quantities of experimental samples.

Subsidence Engineering

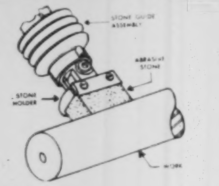
LAND SINKAGE from subsurface oil extraction is being stabilized with a huge water-flooding project at Long Beach Harbor, Calif. Two additional water-injection plants—one on Terminal Island and one on the mainland—were recently completed at a cost of nearly $3 million plus the cost of drilling 98 injection wells. A vast network of water-distribution lines, run above ground where possible, will have a capacity of nearly 500,000 bbl per day.

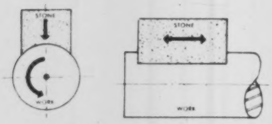
"The purpose of the systems is to take salt water from source wells and to distribute it to injection wells to be injected into the subsurface at high pressures ranging from 850 to 1250 psig," states M. A. Nishkian, Mem. ASME, consulting engineer for the unusual project. At each injection-well head, an orifice-type meter will measure and record the injection flow rate to the well. A flow-control valve or beam will also be placed in the line at each injection well to provide a means of regulating and adjusting flow rates.

Injection salt water will be supplied by source wells. The natural filtration of the salt water by the earth, and its low oxygen content, make it preferable to untreated sea water. The source-well pumps are all stainless-steel deep-well submersible-type pumps that discharge through a pressure-control valve to a desander. The pressure-control valves also control dump to insure a constant supply pressure and continuous working.

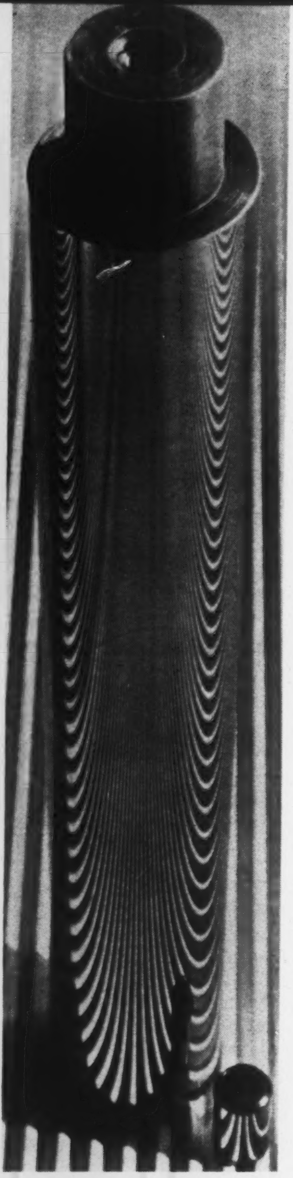
Source water is piped from the desander through plastic-coated steel pipe to the pumping plants. Chemical treatment of the injection water is provided by proportion chemical feeders at the source well and injection-pump suction. The chemical treatment is provided to act as a corrosion inhibitor in the pumps and distribution system and to prevent bacteria growth in the entire system and injection wells.

Encouraged by the success of operations which have halted sinkage of land over a large area, a full-scale water-injection program will eventually encompass the entire Wilmington Oil Field, an area of 20 sq miles. Wilmington, the nation's second richest oil-field reserve, has 6800 acres developed and 5200 acres undeveloped. Subsidence has been halted in 500 acres and the rate of subsidence has been reduced in an additional 700 acres.





Microstoning attachment uses an oscillating soft abrasive stone which quickly conforms to the workpiece to achieve a mirror finish on practically any material. It also exposes and corrects geometric errors.



Microstoning

An abrasive final-finishing process that generates a controlled microinch finish on practically any material and at the same time corrects geometrical errors caused during previous machining operations has been announced by the Taft-Peirce Manufacturing Company, Woonsocket, R. I.

The improvement in surface finishing, called Microstoning, can generate a finish even to less than 1 microin. It is basically a low-pressure, low-temperature abrading operation that uses bonded abrasive stones of various grit sizes. The load is of such a nature that it shapes itself readily to the mean work radius, and wears away in a uniform manner that always presents fresh cutting edges to the work.

Microstoning removes the amorphous skin and other imperfections left by previous machining and imparts a fine finish to the base metal, which results in a sounder metallurgical structure. In addition to generating a uniform, controllable microinch finish, Microstoning exposes and corrects geometric errors such as lobed out-of-roundness and grinding feed or chatter marks.

By choosing stones of corresponding hardness, it is possible to finish soft metals just as easily as hard ones, without loading the surface with abrasive particles.

Microstoning is accomplished by using a Supfina Machine Tool attachment originally developed by the West German Machine Tool Firm of Supfina-Wieck & Hentzen and licensed exclusively to Taft-Peirce for manufacture and sale in this country. The attachment can be used on engine lathes, vertical turret lathes, boring mills, and planers. The patented device oscillates at its natural frequency by means of a unique pneumatic system that uses a minimum of compressed air. A free-floating piston inside the head moves in opposition to the body, resulting in freedom from externally transmitted vibrations. This self-balancing principle allows the attachment to oscillate at high frequencies, from 2000 to 3000 per min, impossible or unsafe to obtain with mechanically driven equipment. The pressure between stone and part is usually kept between 20 and 40 psi.

Most Microstoning is done with vitrified bonded-abrasive stones, using silicon-carbide abrasive in grit sizes 300 to 1200. Coarser stones are available with aluminum-oxide abrasive. The stones are made variable in hardness, just like grinding wheels, with harder grades for soft workpieces, and vice versa. The initial grit size to use depends on the roughness of the workpiece; the final one depends on the finish desired.

Automation in Its Infancy

"Automation is still in its infancy," according to Allen V. Astin, Director of the National Bureau of Standards. Dr. Astin stated at the recent dedication of Leeds & Northrop's Research and Development Center:

"We still have a long way to go before we will have a completely integrated and automated industry. We still are in need of considerable understanding of the communication systems between devices. There is still a large philosophical problem to be worked out. We must come to a better understanding of how the high-speed arbitrary world of machines can logically deal with the real world of production and marketing. We must link technology to communications theory through advanced control instruments.

"Automation is more than the substitution of machine power for muscle power. It carries with it the profound notion that man may delegate to machines certain limited types of decisions, including the technique of continuous sampling by sensing devices. This promises to provide the flexibility to change any or all phases of a process as a result of machine analysis and control. Eventually we will find that automatic electronic devices will link production and marketing. There are today a number of examples in which automatic electronic-data-processing equipment ties plant production to the problems of marketing and management. Unfortunately, these examples are as much characteristic of our halting advances as they are of our progress. The road to automation is not automatic. It will take considerable scientific effort."

Dr. Astin also spoke of the interrelatedness of conceptual development and experimentation—new concepts, arising from experiments and observation, lead in turn to further experiments and observation.

"This regenerative nature of scientific research," he said, "revolves around the continual refinement and extension of the methods and devices for experimenting and observing. An instrument of increased accuracy, or a new method of using an instrument to reduce systematic errors, can give rise to new concepts. Likewise, completely new instruments or instrument techniques can generate revolutionary concepts. In turn, the new concepts continually create demands for new or improved instruments and techniques. The process is reciprocal and energizing."

Dr. Astin was the principal speaker at the dedication of the new 65,000-sq-ft $1,718,000 R & D Center built to accommodate 150 persons, and so designed and located on the plot that it can be readily tripled in size. It is built on the basis of a 4-ft module for both exterior walls and interior construction. Standard insulated metal partitions are used. These were selected even though considerably more expensive than other types of construction because they can be moved and re-erected at quite low cost.

To facilitate additions and changes, all distribution of utilities is overhead and exposed rather than within partition walls. The penthouse is of distinctly unusual design. It houses the air-cooling unit, fans for the air-conditioning system, various pumps, and electric generators. It is supported independently from the remainder of the building to isolate vibrating equipment.

The L & N research organization, now over 40 years old, is divided into a science-oriented Research Division with sections on physics and nucleonics, electrical, chemical, metallurgical, and systems analysis; and a product-oriented Development Division with sections on analysis instrumentation, automatic control, electric power, and data systems. A staff of 129 scientists and supporting personnel is under the direction of Dr. Raymond C. Machler.

Computer May Eliminate Cash!

Electronic-computer technology and a universal-credit-card system may make it possible to eliminate business transactions by cash or check in the future, according to Stanley M. Humphrey, Mem. ASME, a partner with Booz, Allen and Hamilton, Detroit management consultants. "From a technological point of view" such a revolutionary change is definitely within the realm of possibility, he states.

Computer technology will make it possible to handle automatically, transactions at shopping centers, utilities, hotels, and public transportation offices, merely by the customer's insertion of a universal credit card, Humphrey stated at a Bendix C-15 Users Exchange Conference. Even income taxes would fall in the electronic do-it-all hopper since company payrolls would be compiled on magnetic tape and transmitted to employees' accounts at national or central-type banks—all of which would have interbank data-transmission equipment.

Both billing and paying would be accomplished automatically, without any personal exchange of money on the part of the customer. Itemized statements would keep him abreast of his financial transactions.

Transactions between individuals such as rental payments to an individual owner, payments of lawyer or doctor fees, and other low-volume transactions will not be subject to mechanization through the recording devices. However, Humphrey pointed out, almost every individual does have access to a device which could be used for sending coded information on low-volume transactions to the bank's data processor—the dial telephone.

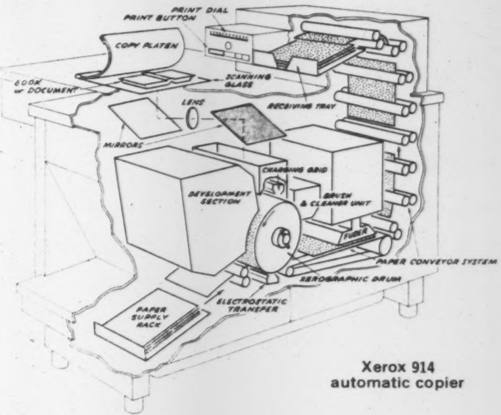
Fully Automatic Copier

A fully automatic office copying machine the Xerox 914 Copier has been introduced by Haloid Xerox, Inc., Rochester, N. Y. Like the company's large-volume Copyflo continuous printers the 914 operates on the fast, dry, electrostatic principles of xerography. The quality of output is brilliant black on white, like printing.

The machine requires no sensitized or treated papers and no exposure or developing adjustments. The required number of copies may be made by simply setting a dial. There is no need to handle the copy paper, or re-handle the original for the multiple copies. It is in this respect similar to a short-run duplicating machine rather than to the conventional copier.

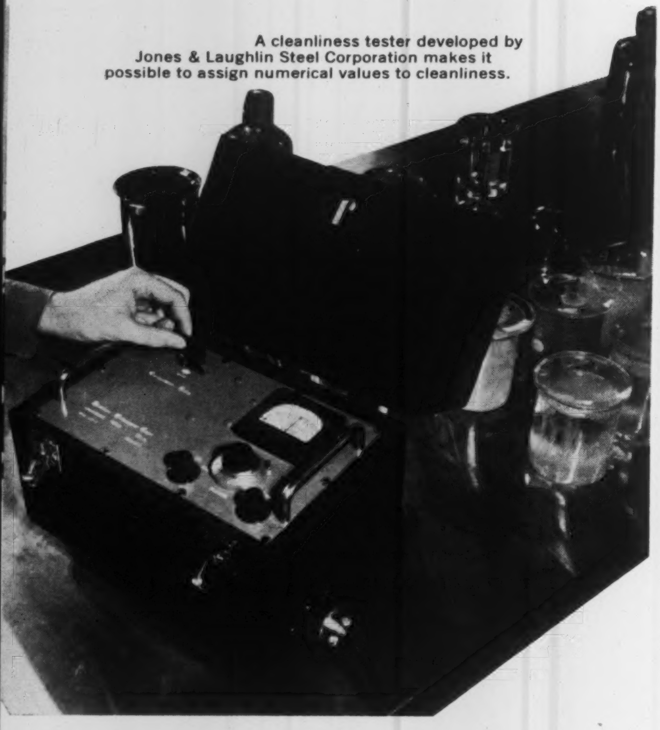
The Xerox 914 copies all colors, and rapidly prints finished, permanent copies of any written, drawn, typed, or printed document up to 9 × 14 in. in size. Copies can also be made from bound books or magazines as easily as from individual documents.

Since the unique device uses no treated or sensitized materials, prints may be made directly on ordinary white or colored paper, offset-paper master material, card stock, or vellum.



Xerox 914
automatic copier

The new machine makes any number of copies from any color original up to 9 × 14 in. at a rate of 6 per min simply by dialing the number desired and pushing the button. Originals may be drawings, letters, magazines, or books of any thickness.



A cleanliness tester developed by Jones & Laughlin Steel Corporation makes it possible to assign numerical values to cleanliness.

Auxiliary Soot Blowing

In place of using steam from the main units for soot blowing, the 5000-psig, 1200-F supercritical-pressure Eddystone Station of the Philadelphia Electric Company will use three 500-psig, 39,500-lb-per-hr, auxiliary oil-fired boilers for this purpose. This is the first installation of this type in a utility plant.

The Foster-Wheeler boilers will supply steam to Vulcan Type T-30 long retractable soot blowers and RW-3E wall deslaggers which are operated electrically through selective-sequence automatic control. The complete soot-blowing system, manufactured by Blaw-Knox Company, Copes-Vulcan Division, is designed to provide for every expected contingency which may be encountered in keeping the main steam generators operating at top efficiency.

The most important feature of the soot-blowing system is its adaptability to various firing situations. The operating sequence of each blower can be changed by simply relocating its control jack cord in a telephone-like jack panel. Thus any blower can be operated at any point in the sequence cycle and, if required, it can be programmed to operate up to a maximum of four times during one complete-sequence cycle. Also, blowing cycles can be terminated at any blower in the sequence by plugging the cord for that blower in a stop jack.

An additional convenience incorporated in the control is a timer motor which permits setting up a 6, 8, 12, or 24-hr soot-blowing program to start the cycle at a predetermined time or recycle the operation as needed.

Even when the system is set for an automatic blowing program, the attendants have complete supervisory control and can stop or change the blowing sequence at any point in the cycle. To facilitate this supervision, each blower has a program light which indicates when it is operating or away from the at-rest position. This over-all versatility insures complete freedom in selecting the optimum soot-blowing sequence for an unexpected as well as a predetermined operating situation. The auxiliary boilers are equipped with Vulcan Type P-3 rotary soot blowers and Copes feedwater regulators.

Measuring Cleanliness

A new tester makes it possible to assign numerical values to surface cleanliness where nonbonded soils are involved. Plating, lithographing, organic coating, and adhesive bonding are typical applications where absence of foreign matter is vital to the success of the operation. The Model CM-1 Cleanliness Tester, developed by the Graham Research Laboratories of Jones & Laughlin Steel Corporation, Pittsburgh, Pa., is manufactured by Branson Ultrasonic Corporation, Stamford, Conn., under a licensing arrangement.

The CM-1, for example, will measure smut residue after pickling of steel. It may also be used to evaluate: (*a*) Detergents and oils used on cold mills, (*b*) annealing-furnace performance, and (*c*) efficiency of electrolytic and alkaline cleaning lines.

The tester has a linear scale from 0 to 1000, where 1000 indicates absolute cleanliness. Accuracy of one part in a thousand is made possible by a 10-turn potentiometer in the balancing circuit. The test is more exact than methods formerly used, such as the water-break and wipe tests. Although these provide a rough indication of freedom from oils, they do not offer a means of determining the amount of finely divided soils adhering to a surface. The Model CM-1 Tester is designed to eliminate this shortcoming.

Testing involves only two steps: (*a*) Soil is removed from the surface under test with transparent, pressure-sensitive tape, which is then affixed to a 25 × 75-mm microscope slide; (*b*) optical density of the composite (tape, soil, and slide) is measured by the tester, which is actually a densitometer designed specifically for that purpose. Readings are direct and give a numerical value for cleanliness.

The unit measures 12 × 14 × 8 in. It weighs only $18^1/_4$ lb, and is easily transported. Power drawn is 50 watts at 110 volts, 60 cps. Slide holder, microscope slides, and tape are supplied with the instrument.

Cleanliness values can be used to compare various cleaning techniques and equipment, to evaluate effectiveness of cleaning agents, and to determine the working life of detergents and solvents. "Cleanability" of various materials is found by successive tests on the same area of a given sample. The number of cleaning cycles needed to remove all contaminants indicates soil tenacity.

Advanced Gas-Cooled Nuclear Plant

The Atomic Energy Commission, has signed contracts with the Philadelphia Electric Company and General Dynamics Corporation, in connection with an advanced high-temperature gas-cooled nuclear power plant that will operate at higher, more efficient temperatures than those now in use or under construction.

A 40,000-net-ekw graphite-moderated, helium-cooled, nuclear reactor will be constructed by Philadelphia Electric for completion by October 1, 1963, on its utility system at Peach Bottom, York County, Pa.

A proposal for the project was submitted jointly by Philadelphia Electric and General Dynamics in response to an AEC invitation issued in September, 1958, for a gas-cooled power reactor. (MECHANICAL ENGINEERING, February, 1959, pp. 84–85.)

The General Atomic Division of General Dynamics Corporation in San Diego, Calif., will conduct pre- and post-operation research and development for the reactor. The AEC will reimburse the company up to $14.5 million and will waive $500,000 fuel-use charges.

Philadelphia Electric will be responsible for the design, construction, and operation of the nuclear power plant, which will cost $24.5 million. The AEC will waive $2 million fuel-use charges through the first 5 yr of operation.

The cost of design and construction of the prototype plant will be shared by Philadelphia Electric and the 51 other utilities comprising the High Temperature Reactor Development Associates, Inc., a nonprofit organization for nuclear research and development.

The fuel elements will consist of uranium and thorium dispersed in graphite and will be graphite-clad. However, metal-clad fuel elements may be used for the initial core of the prototype plant since they require less research and development. If used, they will be replaced by graphite-clad elements after sufficient information is available to establish the feasibility of operation with a graphite-clad core. The graphite-clad core should produce more economical power costs.

Magnetohydrodynamics

THE understanding of magnetohydrodynamics—which is concerned with the manner in which magnetic fields interact with electrically conducting fluids—has reached a very advanced stage in the past few years, according to Osman K. Mawardi, in "Magnetohydrodynamics—A Survey of the Literature," in the July, 1959, *Applied Mechanics Reviews*, published by ASME, pp. 443–446.

This is mainly the result, he states, of intensive investigations which have been instigated by attempts made to achieve controlled-nuclear-fusion reactions, by the study of high-speed vehicles, and by recent progress in astrophysics and geophysics. Although several earlier attempts had been made to discuss the behavior of conduction currents in an ionized gas (plasma), no systematic study of the motion of a fluid immersed in a magnetic field was started until 1942 when H. Alfvèn wrote his now classical paper (*Arkiv för Matematik, Astronomi och Fysik*, ser. B, vol. 29, no. 2, 1942) which was later followed by his monograph "Cosmic Electrodynamics," Oxford University Press, 1950.

The literature has grown considerably, and the review includes 58 citations. The subject matter has been divided into five parts: (*a*) Governing equations for the motion of the fluid, (*b*) dynamical theory of magnetohydrodynamic waves of small amplitudes, (*c*) magnetohydrostatic considerations, (*d*) instability, (*e*) present understanding of magnetohydrodynamic shock theory.

Canadian Turboprop

CANADIAN Pratt & Whitney Aircraft, Montreal, has announced Canada's first turboprop engine, a small, lightweight free-turbine engine designed for low-cost use in light planes and helicopters.

Designated the PT-6, the engine weighs 250 lb and develops 500 equivalent shp. In its turboprop form, it will be used in light planes. Turboshaft installations will be used in helicopters. It will also be used in vertical-take-off-and-landing craft and the design permits continuous engine operation with the thrust axis inclined from 45 deg nose down to 110 deg nose up.

The turboprop version has a guaranteed maximum specific fuel consumption of 0.69 lb per equivalent shp per hr. The turboshaft model weighs only 225 lb, 25 lb less than the turboprop version. The shaft engine produces 500 hp at take-off conditions.

Designers reversed the conventional engine layout in the PT-6, avoiding the use of concentric shafting. Most installations will utilize a scoop-type cowling inlet. The air enters the engine near the rear of the nacelle, similar to the carburetor-scoop position on piston-engine aircraft, and is compressed by a single compressor assembly connected to the first turbine. The second, or free turbine, is spun by the gas flow from the first turbine and is directly linked through reduction gearing in the nose section to the propeller shaft. Exhaust gases are discharged through twin ports on each side of the nacelle aft of the nose section.

A single stage of gearing provides 6000 output shaft rpm for the turboshaft version. A second stage of gearing in the turboprop version provides 2400 propeller rpm.

Developmental testing now is under way, and prototype flight engines will be available in 1961.

Nonporous Aluminum Films

A PROCESS for vacuum deposition of highly protective corrosion-resistant thick aluminum films on steel has been developed by National Research Corporation, Cambridge, Mass., according to *Chemical and Engineering News*, May 25, 1959.

The films are nonporous, ductile, tightly adherent, and have properly oriented crystal structure. They can be anodized by standard commercial processes to provide abrasion-resistant coatings with even greater corrosion protection.

The process, whose details are not revealed, should make it possible for aluminum to replace thick cadmium films where unsatisfactory. These cannot be exposed to unstable, organic electrical insulation and other materials with unsaturated carbon-carbon bonds (such as those in oil paints) or certain conditions above 500 F.

Samples exhibited no cracking or lifting of a 0.0015-in. aluminum coating on $^1/_{16}$-in. steel even when bent over a 180-deg angle over a $^1/_8$-in. diam. The 190,000-psi tensile strength of heat-treated steel coated with about 1 mil of aluminum remained the same and the aluminum did not flake or crack below the yield point of the steel.

Turbine, Generator Plant Improvements

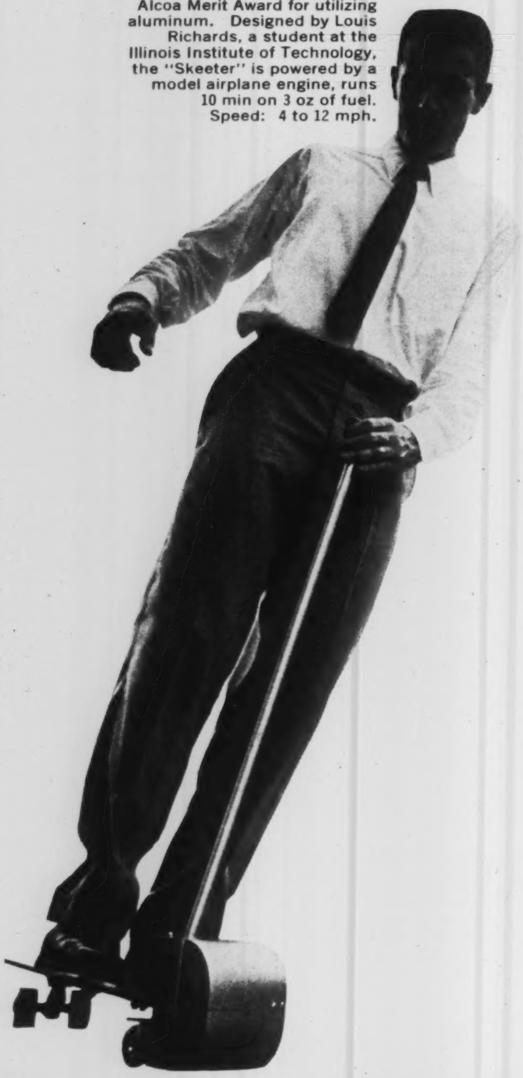
WESTINGHOUSE ELECTRIC CORPORATION will spend more than $25 million to expand and modernize facilities for the manufacture of turbines, generators, large motors, and related heavy apparatus at plants in Lester, Pa., East Pittsburgh, and Sunnyvale, Calif.

The extensive program was initiated to provide adequate manufacturing facilities to meet anticipated peak loads during the 1962–64 period.

Largest segment of the coast-to-coast program is a $21 million modernization and rearrangement at the company's steam division at Lester to be completed in 1961 with a one-third increase in production capability.

PHOTO BRIEFS

Prize-Winning Invention
This unique design for a minimum pedestrian vehicle won an Alcoa Merit Award for utilizing aluminum. Designed by Louis Richards, a student at the Illinois Institute of Technology, the "Skeeter" is powered by a model airplane engine, runs 10 min on 3 oz of fuel. Speed: 4 to 12 mph.



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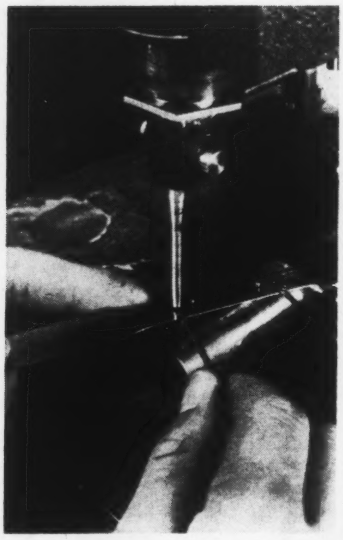

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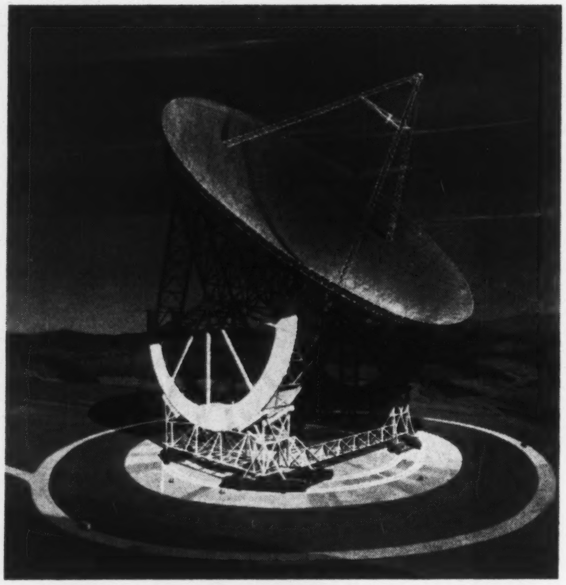
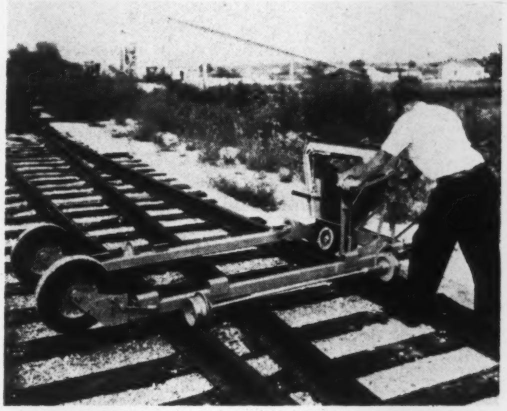


1 **Ball-Socket Attachment.** Extensometer arms are attached to test specimens for protracted elevated-temperature tensile tests by welding ordinary $^3/_{32}$-in. steel balls to the test specimens under precise temperature, force, and cleanliness conditions. The balls attach to sockets on the extensometer arms in traditional ball-and-socket linkages. Boeing Airplane Company research engineers devised method to prevent slippage possible in clamping.

2 **U. S. Radio Telescope.** When completed in 1962, the 20,000-ton, 600-ft-diam radio telescope at Sugar Grove, W. Va., will dwarf the 250-ft Jodrell Bank installation in England, now the world's largest. It will probe 19 times as far into the universe as the 200-in. optical telescope at Mount Palomar, Calif. Grad, Urbahn & Seelye, New York architects-engineers, are designing the facility for the Naval Research Laboratory. Mechanical-engineering solutions to difficult thermal-expansion problems are classified. So are details of the mechanisms which permit elevation of the reflector in any direction between horizons and 360-deg rotation of the entire structure.

3

4



3 Multiform Fused Silica. The exploitation of the unique thermal and electrical properties of pure silica glass is made possible by a new forming process developed by Corning Glass Works. It can be formed into cylinders, domes, crucibles, rods, or slabs. Fused silica can withstand long-term use above 1700 F and intermittent use to 2250 F and has a coefficient of thermal expansion of 3×10^{-7} per deg F. In a plasma jet which can create pinpoint temperatures like those of re-entry, the silica vaporizes rather than melting and flowing as a liquid.

4 Portable Rail Grinder. "Secondary rail-end batter" from bolted rail joints, or irregularities caused by welding, can be removed in half the time of conventional methods with a new portable rail-surface grinder developed by the National Cylinder Gas Division of Chemetron Corporation. One man rolls the gasoline-engine powered machine which utilizes a continuous abrasive belt. The unit slides to either end of the carriage to grind the right or left rail. Rubber tires make it possible to lift the machine on or off the track in wheelbarrow fashion.

5

6

5 Breathing-Unit Clown. Human-factors engineering for the hospital: To allay a child's fear, this forced-breathing apparatus has been made to resemble a clown's face. Each time the young patient draws a breath through the candy-striped hose, the clown rolls a friendly eye, actually a pressure gage. The "Pediatric Ventalung" has been introduced by the National Cylinder Gas Division of the Chemetron Corp. Bright red "nose" is emergency button.

6 Versatile Test Loop. The full line of Westinghouse canned-motor pumps for controlled-circulation-boiler applications can be tested with a versatile "twin-loop" test facility at Cheswick, Pa. Pumps with volutes from 12 to 20 in. in diam and capacities to 22,000 gpm can be handled without changing the basic configurations. Connections for volutes of different sizes are easily changed with bolted flanges which eliminate the welding previously necessary. Over-all motor and hydraulic performance is checked in at least 50 hr of testing. Two discharge arms permit testing of double-discharge pump volutes under actual operating conditions.

Engineering
Progress in the
British Isles and
Western Europe

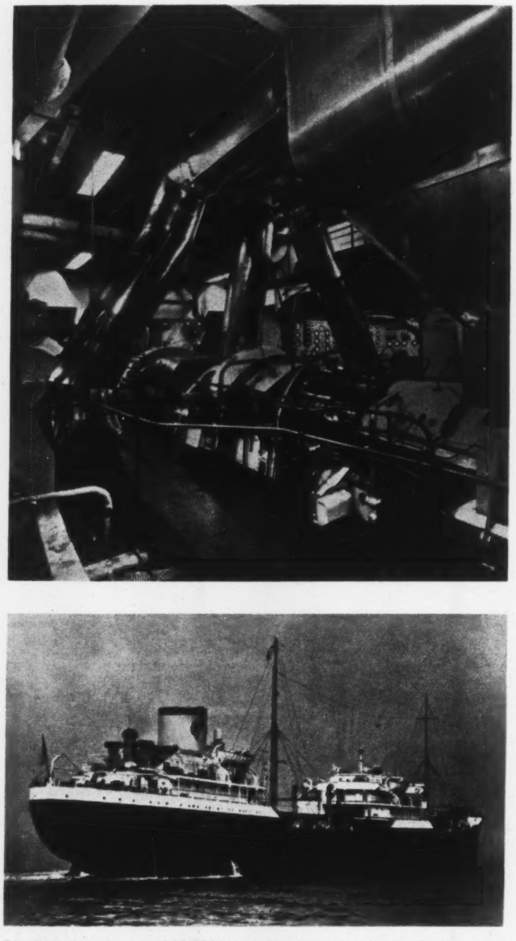
J. FOSTER PETREE
European
Correspondent

EUROPEAN SURVEY

Gas-Turbine Tanker

THE 12,000-ton tanker *Auris*, belonging to Shell Tankers Ltd., has now gone into service with her new machinery. She is the first tanker to rely solely on gas turbines for propulsion. As built in 1948 by Hawthorn, Leslie & Company at Newcastle-upon-Tyne, England, she was fitted with four Hawthorn-Sulzer diesel engines, each driving an alternator, the output from the four alternators supplying a single electric motor which drove the propeller. The combined horsepower was 3750 at a propeller speed of 120 rpm. In 1951, as an experiment, one of the four engines was removed and replaced by a gas turbine. This was so successful that the owners decided to take out the remaining three oil engines and the experimental gas turbine, and to fit a larger gas turbine as the only means of propulsion. The contract was placed with Cammell Laird & Company (Shipbuilders and Engineers) Ltd., Birkenhead, the new turbine being designed by the British Thomson-Houston Company and constructed jointly by them and Cammell Laird.

The new turbine installation develops 5500 bhp, with the high-pressure turbine running at 5800 rpm and the low-pressure at 3840 rpm. The power is transmitted to the propeller (which runs at 120 rpm, as before) through double-reduction gearing. There is no reverse turbine; instead, the gearcase contains a hydraulic coupling for the ahead rotation of the propeller and a reversing torque-converter for astern working. There are two axial-flow compressors in series, with an intercooler between, the low-pressure compressor being driven by the low-pressure turbine, which also delivers the power to the propeller shaft, and the high-pressure compressor by the high-pressure turbine. The turbine inlet temperature is 650 C max. The pressure ratio is 6:1 and the intercooler thermal ratio is 84 per cent. The designed fuel rate is 0.52 lb/bhp/hr, burning oil with a lower calorific value of 17,500 Btu/lb. On the trials, which lasted two weeks, the fuel used was gas oil, but in addition a 24-hr trial at 3600 shp was run on a boiler oil of 1200 sec Redwood I viscosity at 100 F, on which the turbines also ran satisfactorily and with a complete absence of exhaust smoke. The fuel consumption worked out at rather more than the designed figure, and it was found that the maximum astern power with the torque converter was somewhat less than the specified 65 per cent of the ahead power; but the set maneuvered readily and the ship made a maximum speed of 14.3 knots instead of the 12.85 knots that was her best with the diesel-electric machinery.


Shell tanker Auris of 12,000 tons deadweight, originally a motor ship, has been fitted with 5500-bhp gas-turbine machinery, **above**, and has successfully completed sea trials, becoming the first tanker to be driven entirely by gas turbine

During the trials the turbine installation was run for

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439 hours light and 510 hours loaded. The number of propeller starts from "stop" was 360. The highest rate of maneuvering was 140 in four hours, including 34 from ahead to astern or astern to ahead, and 36 starts from "stop." The minimum time to stop the propeller shaft from 86 rpm was 13 sec. In all, 2541 miles were run ahead from 62 miles astern.

The object of the experiment, the Shell Company states, was to find out whether gas turbines showed any advantage over steam turbines or diesel engines for ship propulsion. Thermally, it was found, the gas turbine was comparable with a steam turbine, but it was at a disadvantage when compared with a modern diesel engine.

It is thought that the maintenance costs will be lower, but not enough to offset the high initial cost of the units.

For this reason, the company does not propose to fit any more machinery of this type, though they may use the new hydraulic transmission, specially designed for the *Auris* by the Pametrada establishment at Wallsend-on-Tyne, in conjunction with a normal steam turbine. They do not condemn the gas turbine outright—in fact, they suggest that it may be found "eminently suitable" in other marine applications.

Measuring the Straightness of Precision Plug Gages

"Precision" and "straightness" are terms which admit of various interpretations. The National Physical Laboratory at Teddington, England, thinks of them in terms of a millionth of an inch, and it was to measure errors of this order of magnitude in the straightness of plug gages that they developed the apparatus.

The apparatus has an interferometer of the Fizeau type, used in conjunction with a micrometer-controlled graticule for viewing and measuring the fringes. These interference fringes are produced, in mercury green illumination, by reflection from the cylindrical surface of the plug and the lower surface of an adjustable optical flat which is coated with bismuth oxide. They are viewed at a magnification of 50 times. The microscope is mounted on a horizontal slide so that it can be moved parallel to the axis of the plug. In operation, the plug gage is placed in a V block, with its axis horizontal, and the inclination of the optical flat is adjusted by means of the leveling screws until the lower surface of the flat is parallel to the cylindrical surface of the plug, and just clear of it. In this condition, fringes are formed parallel to the axis of the plug and are symmetrically disposed on either side of the uppermost generator. The position of the V block is initially fixed so as to define an axis in the plane of the optical axis of the microscope and parallel to its transverse motion; thus the center of the fringe pattern is maintained in the center of the microscope's field of view. The first-order fringe on each side defines the straightness of the generator, and any deviations from straightness are shown by the variation in the separation of the two fringes about the axis. This affords a very rapid test for determining that the generator is straight within 10.8 microinches (i.e., half the wave length of the green mercury light) by traversing the microscope from one end to the other. Errors in straightness can be measured by applying the micrometer-controlled graticule in the microscope, at known intervals along the cylinder.

New Diesel Engine

While the believers in gas turbines are steadily progressing toward higher powers and new applications, the makers of big diesel engines are not standing still.

All of them have been designing more powerful units to meet the requirements of the larger tankers now being built in considerable numbers.

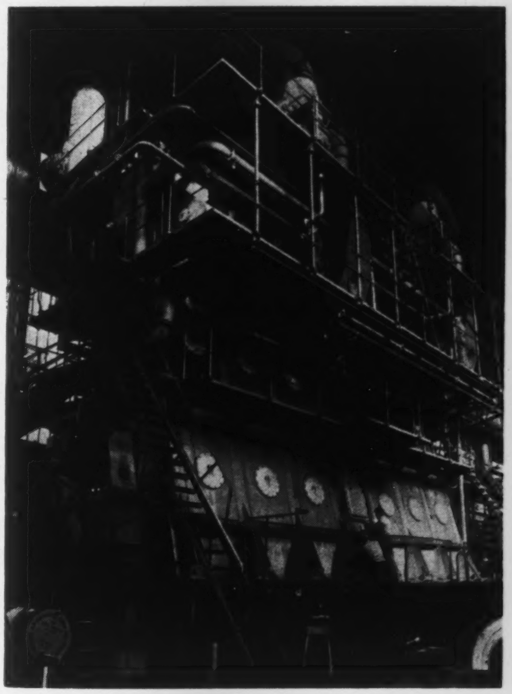
One of the latest new designs is a two-stroke single-acting turbocharged engine built by Burmeister & Wain, of Copenhagen, Denmark, which develops 2100 bhp per cylinder. It is designated the 84-VTBF-180 type and has cylinders of 840-mm bore and 1800-mm stroke.

The prototype unit, which recently ran its shop trials, has six cylinders and a service rating of 10,300 bhp at 110 rpm.

The unit is now being fitted in a tanker of 19,000 tons dead-weight capacity, under construction for the East Asiatic Company. The design provides for the building of engines up to 12 cylinders, delivering 25,000 hp to a single propeller and suitable for tankers of 65,000 tons.

The East Asiatic Company were the owners of the pioneer seagoing motorship *Selandia*, built in 1912 and also engined by Burmeister & Wain. She had two engines, driving twin screws, and it is a striking indication of the progress since made that her total horsepower was less than that obtainable from a single cylinder of this latest Burmeister & Wain engine.

Burmeister & Wain two-stroke single-acting turbocharged diesel engine develops 2100 bhp per each of its six cylinders and is now being fitted into a new tanker



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Staff Editor

ASME TECHNICAL DIGEST

Petroleum Mechanical Engineering

Magnetic-Type Mechanical Seals..59—Pet-35... By A. W. Lighter, A. W. Chesterton Company, Everett, Mass. 1959 ASME Petroleum Mechanical Engineering Conference paper (multilithographed; available to July 1, 1960).

A mechanical seal may be described as a sealing device which achieves its primary seal between two relatively rotating optically flat surfaces which are generally in a plane perpendicular to the axis of rotation. The two sealing elements which contain the primary-seal surfaces then must be sealed in some manner, one to the rotary shaft and one to the stationary housing.

Four years ago, the basic idea of utilizing magnetic attraction between the rotary and stationary seal members was conceived. It was theorized that if a nonmechanical pull could replace the mechanical push of the compression springs used in the conventional mechanical seals, the problem of critical installation and adjustment would be eliminated. There also appeared to be a possibility of drastically reducing the seal length if the magnetic attraction principle proved sound.

An effective magnetic-type mechanical seal has been developed.

This paper constitutes a progress report on the development of such seals. The report includes the basic application of these seals and briefly describes their evolution.

Sonar Caliper Surveys of Underground Caverns..59—Pet-14... By G. D. Patterson and S. G. Williams, Dowell Division of the Dow Chemical Company, Tulsa, Okla. 1959 ASME Petroleum Mechanical Engineering Conference paper (multilithographed; available to July 1, 1960).

Solution mining has become an established method for recovering water-soluble minerals from below the surface of the earth. A well bore is drilled into the mineral deposit, tubing and casing set, and fresh water pumped down the well bore. This water dissolves out the mineral and is circulated back up to the surface, where the dissolved salt is recovered from the resultant brine. As a result of such mineral removal, caverns of considerable size are often formed underground.

This technique has also been utilized for the purpose of obtaining large-capacity storage for LPG or other petroleum products. In this case, the primary purpose is not the recovery of salt, but rather the creation of a large, leakproof underground cavity which will be suitable for storage purposes.

Naturally, whatever the purpose of the underground cavern, accurate knowledge of its size and shape will be of material assistance to the engineer in charge, in controlling brining schedules, and avoiding remedial operations. The following is a partial list of the uses to which such information may be put:

1 To determine roof structure.
2 To measure cavity size.
3 To determine cavity shape.
4 To check brining schedules.
5 For exploratory purposes.
6 Prior to remedial operations.
7 As a guide during completion.

Gas Turbines—Installation and Operational Problems and Performance Evaluation..59—Pet-9... By Charles Bultzo, Mem. ASME, Humble Oil and Refining Company, Baytown, Texas. 1959 ASME Petroleum Mechanical Engineering Conference paper (multilithographed; available to July 1, 1960).

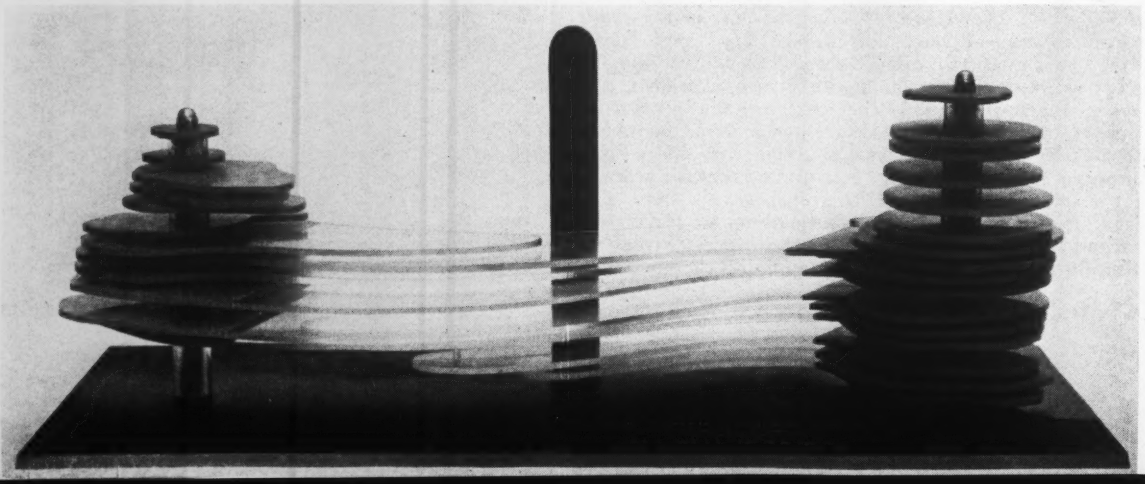
Gas-turbine technology continues to improve, yet certain problems continue to exist.

This paper is concerned with the lube-oil installation, instrumentation, and operational fouling of the axial compressor for a simple-cycle, two-shaft, 5000-hp gas turbine.

The turbine studied drives a high-capacity centrifugal blower supplying regenerator air to a fluid catalytic-cracking unit. For maximum over-all thermal efficiency, the hot exhaust gases are combined with the regenerator air after it leaves the process unit to generate 600-psig steam by burning the CO in the combined stream.

It was found that the common problem of getting a clean lube system in a new machinery installation was checked

Model of sonar caliper surveys on adjacent, interconnected solution mining wells located 300 ft apart and connected by a tunnel (59—Pet-14)



considerably by: Acid cleaning the pipe before assembling, proper location of the filter, and proper welding procedure.

Simplicity and greater flexibility for servicing are recommended to improve instrumentation.

Catalyst cleaning is suggested as a unique method of reducing the fouling rate of the axial compressor.

A heat balance is discussed which provides a fairly rigorous method by which field personnel can determine the performance of a gas turbine.

The Derivation and Programming of Equations for Calculation of Centrifugal-Compressor Performance on an Electronic Computer..59—Pet-21...By M. G. Wallington, United Gas Pipe Line Company, Shreveport, La. 1959 ASME Petroleum Mechanical Engineering Conference paper (multilithographed; available to July 1, 1960).

Graphical analysis is now widely used in the presentation of centrifugal-compressor performance, using several approximations in the manual computations involved.

Direct calculation of performance from basic compressor data has not been possible because of the fact that certain empirical coefficients (mathematical expressions for which had not been established) are involved in the general relationships. The derivation of mathematical expressions for these coefficients permits direct calculation.

The repetitive nature of the calculations, the complexity of the equations, and the fact that a trial-and-error solution is required under certain conditions, make the use of an electronic computer almost a necessity for direct calculation.

This paper presents the development of equations for these coefficients and presents one program which has been used in directly calculating centrifugal-compressor performance from basic compressor data. The program presented is general and is applicable to any centrifugal compressor, although it was originally prepared for and has been used exclusively for natural-gas pipeline compressors.

Cooling-Tower Specification and Design..59—Pet-6...By G. M. Anderson, Mem. ASME, Fluor Products Company, San Rosa, Calif. 1959 ASME Petroleum Mechanical Engineering Conference paper (multilithographed; available to July 1, 1960).

Water conservation is becoming increasingly important. As a result, it has become necessary for the cooling-tower industry to produce towers that will supply cold water efficiently and economically.

Although there are several types of cooling towers being manufactured today, the majority are mechanical draft, which employ motor-driven fans to induce air circulation. The design most commonly used in this country today is the mechanical induced-draft type. In this type the fans are placed on the top of the tower, the air is induced through the base of the tower at the louvers, drawn up through the tower, and exhausted out the fan stacks. The small cross-sectional area opening of the fan stack results in a relatively high discharge velocity minimizing recirculation of moist air.

Induced-draft towers are of two basic types: Counterflow (air traveling countercurrent to the falling water) and crossflow (air moving horizontally and at right angles to falling water).

The process of cooling industrial water is complicated and to a large extent subject to the variations in weather conditions. A suggested procedure to be followed in specifying a cooling tower is given.

Factors Governing the Design and Use of Air Fin Coolers..59—Pet-27...By H. N. Worsham, Coynco Products, Inc., Tulsa, Okla. 1959 ASME Petroleum Mechanical Engineering Conference paper (multilithographed; available to July 1, 1960).

A relative newcomer to the field of process heat-transfer equipment is the extended-surface exchanger. Many configurations of fins and prime transfer surface are presently available, but one in particular promises to become a most useful device for cooling purposes. This is the air-cooled exchanger, which effects the removal of heat from process fluids flowing inside tubes by passing atmospheric air across the outside of the tubes. Since the heat-transfer film coefficient for the air is usually quite low compared with that for the process fluid, fins are placed on the external surface of the tubes, resulting in the removal of more heat than possible with bare tubes alone.

The widespread use of air-cooling was for many years forestalled by an abundance of cooling water, the resistance to change from established practices, and the lack of data to design extended-surface air coolers effectively. The lack of cooling water in many areas, together with the increased demand on existing water sources, forced the serious consideration and eventual use of air-cooling on a large scale. Now, after some years of experience with the application of air-cooling in a wide variety of service conditions, and through a great deal of research, it is now possible to design an air-cooled exchanger, assured in advance that the unit will meet minimum duty requirements.

This presentation includes pertinent information about MTD (Mean Temperature Difference) corrections, fans, air distribution, the effects of varying ambient air temperature and inadequate air delivery, and guides for the prevention of performance difficulties in air coolers.

Water Treatment and Cooling Tower Maintenance..59—Pet-28...By P. G. Ketcham, Humble Oil and Refining Company, Houston, Texas. 1959 ASME Petroleum Mechanical Engineering Conference paper (multilithographed; available to July 1, 1960).

The extent to which cooling water is treated in a gas plant is largely a matter of economics. Given a source of make-up, the quality of cooling water can be adjusted to and controlled at any degree of purity for a price. Water-treating equipment investment and operating costs must be justified by a reasonable pay-out just as any other plant facility is justified. In a typical gas plant, water-cooled heat exchangers, cooling towers, water-distribution systems, circulating pumps, and other water-handling equipment may represent as much as 20 per cent of the total major equipment cost or 10 per cent of the total plant investment. The proper treatment and conditioning of water for use as make-up therefore represents an important phase of the gas-plant operation, and reasonable water-treating costs are easily justified.

The fouling of critical heat-exchanger surface with scale or bacteriological growths will reduce the rate of heat transfer and may result in an appreciable loss of liquid hydrocarbon recovery and plant income. This is particularly true of those plants which are designed for high propane recovery. Uncontrolled water-side corrosion may result in the premature failure and early replacement of expensive heat exchangers, water piping, and pumping equipment, as well as a loss of plant products until necessary repairs can be made where a plant shutdown is involved.

It follows then that a sound program of water-treating and cooling-tower maintenance will pay dividends. Such a program can be developed effectively only through proper planning. The problem should be defined, various possible solutions considered, and conclusions developed for a definite course of action. These plans should include (*a*) the development of a suitable supply of water, (*b*) the selection of the most effective and economical treating method, and (*c*) the proper maintenance of equipment. This paper discusses each of these items.

Cooling System Operation and Maintenance..59—Pet-31...By M. J. Crowley, El Paso Natural Gas Company, El Paso, Texas. 1959 ASME Petroleum Mechanical Engineering Conference paper (multilithographed; available to July 1, 1960).

The cooling system is basically broken down into three units: Engine jacket-water system, engine oil-cooling system, and pipeline gas cooling.

The engine jacket-water system is a totally enclosed circulation system, the heat-removal unit being an atmospheric fin-fan unit.

The oil-cooling water is again a totally enclosed circulation system with the heat-exchange unit of the oil being a shell-and-tube engine-mounted unit. The cooling water is then circulated through a bent-tube section in the induced-draft cooling tower.

The pipeline gas cooling is accomplished by circulating the discharge gas through bent-tube sections in the same induced-draft cooling tower. The application of the atmospheric fin-fan sections is dependent on the ambient conditions existing at the station site. However, in some cases these have been eliminated and all heat exchangers were placed in the cooling tower.

This paper discusses the cooling installations of pipeline compressor stations. Generally speaking, the author's company has three types of compressor stations: Horizontal reciprocating, vertical reciprocating, and centrifugal. The cooling systems of these plants differ enough to create different problems and necessitate the use of procedures which are peculiar to each particular type plant.

Practical Applications for High Strength Ceramics in the Petroleum Industry..59—Pet-40...By B. D. Landes, Mem. ASME, Coors Porcelain Company, Golden, Col. 1959 ASME Petroleum Mechanical Engineering Conference paper (multilithographed; available to July 1, 1960).

High strength ceramics are important industrial materials today because of their chemical inertness, extreme hardness, and high melting temperatures.

They have found numerous applications in areas plagued by corrosion, erosion, and high-temperature problems.

Current information on the uses of high strength ceramics in the petroleum industry is presented in this paper.

Work done on the application of ceramic coatings to metals or other materials is described.

Three different techniques have been used in the most recent work on ceramic coatings. The first involves the use of powders which are sprayed with an oxyhydrogen torch. The second method was developed for tungsten carbide coatings, and in this a mixture of oxygen, acetylene, and tungsten carbide powder is exploded and directed toward the surface to be coated. The third technique involves the use of a ceramic rod which is fused in an oxyacetylene flame and then blown onto the surface to be coated while still in the molten state—the ROKIDE process.

Brake-Block Requirements for Oil Field Drilling and Servicing Rigs..59—Pet-38...By F. W. Barton, Jr., Beddaway Manufacturing Company, Inc., Newark, N. J. 1959 ASME Petroleum Mechanical Engineering Conference paper (multilithographed; available to July 1, 1960).

Three distinct types of machines are used in the drilling and servicing of oil and gas wells: Rotary-drilling rigs, cable-tool drilling rigs, and well-servicing rigs.

Brakes employed on the drilling, hoisting, or servicing drums on those machines are designed to give optimum performance under any and all types of field conditions. Extreme demands are therefore placed on the brake blocks thereby necessitating certain basic requirements in their construction.

The purpose of this paper is to present the basic qualities and constructional features which should be incorporated in the brake blocks to make the brakes perform as the builder intended they should.

The importance of the shape of the brake, friction, brake-block cooling, water and oil resistance, equalizing brakes, and brake-block attachment are considered.

The Development and Testing of a High-Temperature Oil Well Drilling Fluid..59—Pet-30...By J. C. Cowan, National Lead Company, Houston, Texas. 1959 ASME Petroleum Mechanical Engineering Conference paper (multilithographed; available to July 1, 1960).

Current drilling operations are engaged in exploring formations at depths of 20,000 to 25,000 ft with temperatures ranging above 400 F. As drilling depths increase, temperatures well above this figure may be expected.

Various high-temperature drilling fluids and additives have been developed simultaneously with deeper drilling, although conventional drilling fluids operate best at temperatures below 400 F. These limitations are usually the result of one or more of the following factors:

1 A thermal or biological breakdown of one or more drilling-fluid components.

2 A decrease in the viscosity of the liquid phase with increasing temperature.

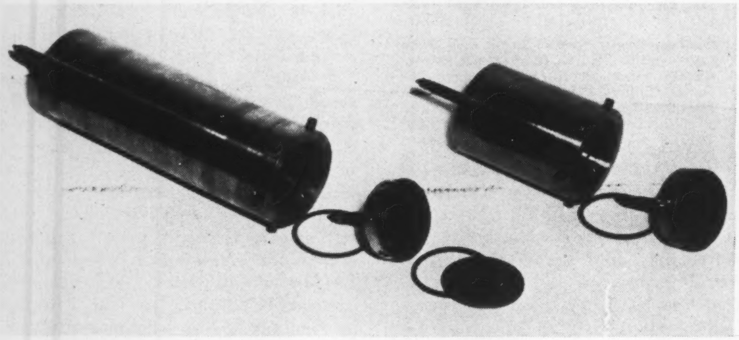
3 A combination of materials that solidify (i.e., lose fluidity) in the presence of high temperature.

4 Or a significant decrease in the solubility of certain electrolytes that permits increased hydration of shale solids.

These environmental alterations can result in an undesirable increase in rheological and filter-loss properties, thus increasing the difficulties of deep-hole drilling. Stuck pipe or casing, poor logging tool runs, blowouts due to swabbing, fishing expenses, and down-time to condition mud may be expected. These difficulties place an economic limit on the depth of rotary drilling.

To overcome these limitations new and old drilling-fluid additives have been tested for use at well temperatures in the range of 300 to 450 F. The determination of the performance of these formulations requires special procedures and testing equipment, hence a considerable part of this study is devoted to techniques and equipment.

Conventional testing equipment had to be modified to obtain reliable data on oil-well drilling fluid at temperatures of 350 to 450 F. Baroid high-pressure, high-temperature filter press was modified and cell-body volume increased from approximately 140 ml to 490 ml. Shown here are modified filter-cell body, **left**, and conventional filter-cell body, **right.** (59—Pet-30)



Materials for Equipment Operated Below Minus 100 F..59—Pet-37...By O. A. Hansen, Linde Company, Division of Union Carbide Corporation, Tonawanda, N. Y. 1959 ASME Petroleum Mechanical Engineering Conference paper (multilithographed; available to July 1, 1960).

Characteristics of all materials of construction are affected by temperature, and it is part of the work of the engineer to select those materials suitable for the conditions of operation. But the reliability of the complete apparatus depends upon more than the proper material. The treatment of that material before fabrication, the methods of fabrication, and the test procedure leave a marked effect on the finished article.

This paper lists some of the low-temperature characteristics of a few common metals (aluminum, copper, nickel, iron, titanium, and magnesium) used in fabricating process machinery, but deals mostly with the unusual problems created by low-temperature operation. Some of the fabricating methods used in building equipment for low temperatures are outlined.

Edge Influence Coefficient for Toroidal Shells of Positive Gaussian Curvature..59—Pet-2...By G. D. Galletly, Assoc. Mem. ASME, Shell Development Company, Emeryville, Calif. 1959 ASME Petroleum Mechanical Engineering Conference paper (in type; to be published in **Trans. ASME—J. Engng. for Indus.**; available to July 1, 1960).

Tables are given for the edge deformations of constant-thickness toroidal shells subject to uniform pressure and edge bending loads.

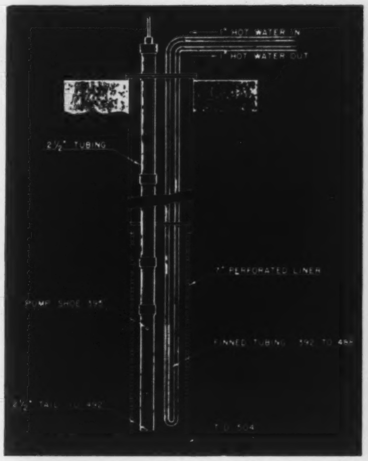
Over one hundred different shell geometries were investigated and the results are presented in dimensionless form.

Possession of these coefficients, which were obtained on a digital computer, means that a rapid and accurate formulation of the compatibility equations at toroidal shell junctions is now possible.

Edge Influence Coefficients for Toroidal Shells of Negative Gaussian Curvature..59—Pet-3...By G. D. Galletly, Assoc. Mem. ASME, Shell Development Company, Emeryville, Calif. 1959 ASME Petroleum Mechanical Engineering Conference paper (in type; to be published in **Trans. ASME—J. Engng. for Indus.**; available to July 1, 1960).

Continuing the work presented in ASME paper No. 59—Pet-2, this paper gives additional tables for the edge deformations of constant-thickness toroidal shells subject to edge bending loads and uniform pressure.

The two papers together thus cover a wide variety of toroidal shell geometries and enable a designer to calculate in a simple manner the edge moments and shears at toroidal shell junctions.



Closed circulating hot-water well-heating system, Yorba Linda Field, Calif. (59—Pet-13)

Heavy Crude Oil Production Problems—A Challenge to the Mechanical Engineer..59—Pet-13...By E. W. Walker, Western Gulf Oil Company, Los Angeles, Calif. 1959 ASME Petroleum Mechanical Engineering Conference paper (multilithographed; available to July 1, 1960).

For the purpose of this paper, heavy crude oil is defined as crude below 15 deg API, since the greatest production problems arise when trying to produce these heavier crudes.

Promoting flow to the well bore and pumping, treating, and shipping of heavy crudes are among the chief production problems encountered. The phenomena which bring about these problems are:

1 High crude viscosity in relation to reservoir, well bore, or normal surface operating temperatures.

2 Unconsolidated producing formations which yield heavy crudes containing entrained sand and silt.

3 Small density difference existing between heavy crudes and produced waters, especially when the waters are fresh.

4 Corrosive waters.

Several mechanical-engineering solutions to these problems are outlined.

50,000 Feet Downhole—In a Modern Laboratory..59—Pet-4...By R. Q. Fields and M. Lebourg, Schlumberger Well Surveying Corporation, Houston, Texas. 1959 ASME Petroleum Mechanical Engineering Conference paper (multilithographed; available to July 1, 1960).

If the history of the well-depth records are plotted and projected into the future, the 50,000-ft well will have been drilled by 1990. The bottom-hole temperature will be between 450 and 850 F and the mud pressure will be about 35,000 psi.

No doubt the drilling of such a well will depend on the solution of many problems.

Probably the ones that will plague the mechanical engineer in the logging and perforating industry the most will be high temperature and mud pressure. In order to meet the requirements necessitated by the rapidly increasing depths, it was necessary to build two new high-pressure testing laboratories in three years. The 1958 lab has a high-pressure test vessel that is interesting. It is a relatively large vessel with a 12-in. ID and a 25-ft working depth. The working pressure is 30,000 psi and temperature 450 F. This vessel certainly makes it possible to simulate the extremes of pressure and temperature of any existing downhole conditions known today.

Materials Used in Railroad Tank Cars..59—Pet-5...By C. T. Graves, General American Transportation Corporation, Chicago, Ill. 1959 ASME Petroleum Mechanical Engineering Conference paper (multilithographed; available to July 1, 1960).

A tank car essentially is a vessel mounted on an underframe and trucks, and transporting any one of about 1500 commodities over the rails. In its movement, it is associated with other cars which frequently contain products valued at more than a million dollars.

It may contain from 3000 to 20,000 gal of commodity at pressures from atmospheric to 450 psig in single-compartment cars, and up to 2400 psig in multiunit cars. Commodities range from waste products through edibles, petroleum products, flammables, chemicals, poisons, acids, liquefied and compressed gases, and gases.

A fleet of about 200,000 tank cars with a normal life expectancy of about 20 years handles this traffic. Much of the responsibility for safe transportation in tank cars lies in the dependable materials used in their construction.

The materials used in the construction of railroad tank cars for petroleum products and petrochemicals are reviewed along with comments on the approach to selection of materials. The review includes the various steels, stainless steels, and aluminum alloys for tank construction; materials for fittings; linings, and coating.

Welding of X56 Pipe..59—Pet-12...By N. F. Blundell, Gulf Interstate Company, Houston, Texas. 1959 ASME Petroleum Mechanical Engineering Conference paper (multilithographed; available to July 1, 1960).

A 350-mile 30-in-diam high-pressure gas pipeline was recently constructed using line pipe of a new specification for the gas industry. The high-carbon pipe steel had a 56,000-psi minimum yield and approached the upper limits of weldability.

All the pipe was electric-resistance welded, cold expanded pipe of $^3/_8$-in. wall thickness. The pipe was manufactured by three different mills in accordance with API 5LX Specification for line pipe with a user agreement as to chemical and physical specifications for X56.

The welding techniques used and the problems encountered during construction of the pipeline are described in this paper.

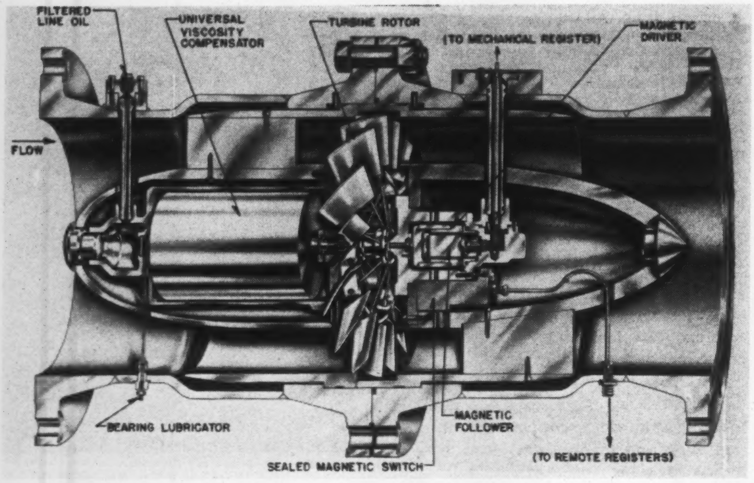
Materials and Construction for Subzero Temperature Service..59—Pet-8... By Milo Palmer, J. F. Pritchard and Company, Kansas City, Mo. 1959 ASME Petroleum Mechanical Engineering Conference paper (multilithographed; available to July 1, 1960).

Classification of materials as to the minimum service temperature in which they should be used depends upon whether the material will be subjected to shock loading or upon a steady static load. If the load is a steady static load, it is obvious that plain-carbon steel would withstand extremely low temperatures. This condition, however, rarely exists in process plants. In piping and equipment it is normal to obtain various degrees of shock; even the steady flow of fluid in a pipe will produce vibration which, depending upon its velocity, will vary from slight to severe vibrations. It is therefore important to select materials for subzero services which will withstand the shock expected at the service temperature.

Some of the nonferrous materials used for subzero temperatures will not withstand very much heat, and in the case of fire may rupture rather quickly. This safety consideration may result in using the ferrous steels.

In the construction of equipment, it is quite common to use different materials to conserve on the more expensive materials of the piece of equipment. The expansion or contraction of these differing materials should be examined closely to make sure that the equipment will not bind rotating parts or warp the piece of equipment to such extent as to make it unserviceable or unsafe.

Of the many methods for measuring the low-temperature embrittlement of ferrous materials, the Charpy keyhole-notch method, is probably the best as it is primarily applicable to the classes of steels of low hardness and low notched-bar impact resistance such as hot-rolled or normalized carbon and low-alloy steels, and permits discrimination between the more and less brittle steels of the aforementioned types at room temperatures and below.



Cutaway view of "compensated" turbine for metering of crude oil. Front half of casing carries the inlet portion of the venturi (or torpedo) which guides the flow into the blading and houses the viscometer or universal viscosity compensator. (59—Pet-7)

Generally for subzero service temperatures a minimum value of 15 ft-lb Charpy keyhole-notch specimen tests are specified for the material at the operating temperature. For some conditions of shock loading it would be desirable to increase the minimum energy from 15 ft-lb to 20 ft-lb or more depending upon the severity of the shock.

Metering Crude Oil With a Turbine..59—Pet-7... By Henning Karlby and W. F. Z. Lee, Rockwell Manufacturing Company, Pittsburgh, Pa. 1959 ASME Petroleum Mechanical Engineering Conference paper (multilithographed; available to July 1, 1960).

Metering crude oil with a turbine is attractive for a number of reasons. The turbine will pass dirt without suffering damage, is the least complicated meter, has good running balance, low head loss, and can be housed inside the normal pipeline. These advantages permit unsurpassed "repeatability" maintained over large throughputs.

In general, however, turbines have not been accepted for this application because the calibration factor (or meter factor) changes too much with flow rate and with viscosity of crude oil.

The reason for this change, and a method of compensating for the change, are described in this paper.

Metering crude oil accurately with a turbine means, in design terms, holding the turbine "slip" constant over the wide ranges of flow and viscosities encountered.

This is not an inherent property of a turbine, but it has been accomplished—as demonstrated by tests—by incorporation of a universal viscosity compensator, without sacrifice of the attractive properties of metering turbines. This compensated metering turbine can be calibrated once without need for the particular liquid to be encountered in service.

Use of Computers in Scheduling for Products Pipelines..59—Pet-10... By C. A. Stapleton, Plantation Pipe Line Company, Atlanta, Ga. 1959 ASME Petroleum Mechanical Engineering Conference paper (multilithographed; available to July 1, 1960).

Probably the most tedious and most time-consuming operation of the modern products pipeline dispatcher is the determination of what is going on at the present time with respect to pipeline operations and what will be going on in the immediate future.

Computers are currently being used as an aid to efficient and accurate control of product-pipeline tenders.

The computer referred to in this paper is a magnetic-drum data-processing machine with accompanying read-punch and power units. Associated equipment includes: Teletypewriters for each circuit, tape reperforators, tape-card punch machine, tabulating machine, card-tape punch machine, and transmitter. A brief description and the functions of each of these pieces of equipment are given.

Selection and Use of Precipitation-Hardening Stainless Steels..59—Pet-17... By M. E. Holmberg, Houston, Texas. 1959 ASME Petroleum Mechanical Engineering Conference paper (multilithographed; available to July 1, 1960).

The precipitation-hardening stainless steels are a new group of engineering alloys offering a unique combination of properties.

These alloys have corrosion resistance comparable to the austenitic chrome-nickel stainless steels, together with the high strengths that can be developed in the heat-treatable chromium stainless steels. The heat-treatments are performed at relatively low temperatures and have certain distinct advantages.

One of these, Armco 17-4 PH, provides the petroleum and petrochemical industries with a long-sought intermediate alloy between Type 410 and nickel-base materials.

Tests show the alloy possesses freedom from copper-acetylide formation; has excellent high-temperature strength; resistance to stress-cracking and hydrogen embrittlement; gives good performance in brine; and may be used under extremely high design stresses. The properties and characteristics of 17-4 PH are reviewed and specific applications discussed.

The Sonic Pump for Wells..59—Pet-18... By G. A. Bodine, Mem. ASME, Bodine Soundrive Company, Los Angeles, Calif. 1959 ASME Petroleum Mechanical Engineering Conference paper (multilithographed; available to July 1, 1960).

The sonic pump is a vibratory mechanism which makes use of the elastic properties of long columns.

The vibratory mechanical movement of the pump is actually an elastic cycle, which can be of substantial magnitude in long columns. Because the columns in deep wells are long we can conveniently develop this elastic movement in the form of an elastic wave action. Furthermore, we can obtain an effective magnitude of vibratory stroke which is still within the safe elastic limits of the column's material.

All materials are elastic, hence the formulas for stress and strain. In most structures, such as the connecting rods in engines, we have greater stretching and compressing than we have in any portion of equivalent length in the sonic pump, but in those more common fairly short members the total elastic motion is so small that it serves no purpose.

Although the safe elongation and contraction of the sonic-pump column amount to about only one part in six thousand, the long column, or long wave length, means that we have thousands of inches to be elastically distorted, so that each momentary incremental distortion of all of this length can easily add up to $^1/_2$ in.

Rationalization of Drilling—Rig Power Plants..59—Pet-19... By W. S. Crake, N. V. De Bataafsche Petroleum Maatschappij, The Hague, Holland. 1959 ASME Petroleum Mechanical Engineering Conference paper (multilithographed; available to July 1, 1960).

Drilling horsepowers have about doubled since the war and this has led operators into increasingly complex power-transmission and distribution problems.

The rig horsepower requirements are complicated by the problem of auxiliaries, the engine problem, additional weight, increase time for rig up and tear down, and such.

In addition, obsolescence occurs rapidly, particularly in cases where engines remain in idle storage or are prematurely junked as a result of overloading.

Each of these problems is reviewed briefly. Various available transmission systems are also reviewed.

The a-c torque converter and the d-c ring are suggested as possible solutions of the transmission problem.

It is concluded that a return to the "central plant" principle, formerly available on the steam rig, can be of much help in simplifying problems of machinery, transport, assembly, and maintenance.

Design of Pipe Supports for Petrochemical Plants..59—Pet-26... By Bruno Laan, The Fluor Corporation, Ltd., Los Angeles, Calif. 1959 ASME Petroleum Mechanical Engineering Conference paper (multilithographed; available to July 1, 1960).

Once the routing of pipes has been roughly established, the type of pipe supports best suited for the particular case has to be determined. It is assumed that the pipes have been properly sized, requirements of flexibility satisfied, and tentative locations for pipe anchors and spring hangers determined.

Discussion in this paper is limited to types of supports which can be used for a great majority of pipe supports in a refinery. These can be grouped in three categories; namely, overhead, at grade, and underground.

Selection of materials and their economic usage are outlined. Details of construction using various materials and methods of erection are explained. Design criteria covering forces on pipe supports, allowable stresses, and foundations are also presented.

Fundamentals of Low-Temperature Insulation..59—Pet-32... By R. L. Anderson, Jr., The Aber Company, Inc., Baton Rouge, La. 1959 ASME Petroleum Mechanical Engineering Conference paper (multilithographed; available to July 1, 1960).

Cold insulation provides means of controlling process temperatures. Low-temperature insulation conserves refrigeration and provides balance and control of process temperatures.

There cannot be one set of specifications designed to fit all insulation problems. Insulation standards set by plants are in most cases good, but each job should be studied thoroughly with correct alterations made to the standards to fit that particular job.

To avoid malfunctions, consideration should be given to proper hangers or pipe supports, cycling lines, and proper sealing.

Moisture—the worst problem in low-temperature insulation installations— is considered from the point of view of selection of materials and their application.

The following ground rules for application are given: Protect materials during storage, plan and schedule field installations, protect partially completed work, be certain all surfaces are completely dry, seal vapor barrier completely, and stick to specifications.

The application of the vapor barrier is described, and a maintenance program outlined.

Prevention of Sulfide-Stress Cracking in Sour-Condensate Well Equipment..59—Pet-36... By W. J. McGuire and L. W. Vollmer, Gulf Research & Development Company, Pittsburgh, Pa. 1959 ASME Petroleum Mechanical Engineering Conference paper (multilithographed; available to July 1, 1960).

Sulfide-stress cracking is defined as the spontaneous fracturing of steel subjected simultaneously to a corrosive hydrogen-sulfide aqueous medium and a static stress less than the ultimate strength of the metal. Sulfide-stress cracking became of major importance to the petroleum industry with the discovery of sour-condensate reservoirs.

Despite the fact that the present knowledge of the sulfide-stress cracking problem has not provided a satisfactory explanation of the failure mechanism, the information that has been accumulated by experimentation and actual service experience has provided means of averting spontaneous failure in sour-condensate well equipment.

The discussion that is presented indicates that freedom from service failures can be achieved by providing materials that are metallurgically satisfactory and by appropriate design, maintaining the applied stresses at as low a level as is practical. The present concepts of the requirements for sour-condensate well equipment indicate the following materials considerations:

1 When well conditions permit, grade J-55 tubing made from plain carbon steel should be used. If the engineering requirements are such that J-55 is inadequate, specially processed N-80 is indicated. Experience has shown that the carbon - manganese - molybdenum steels

Metallurgical Evaluation of Superheater-Tube Alloys After Six-Months' Exposure at Temperatures of 1100 to 1500 F..59—Pwr-1...By C. L. Clark, Mem. ASME, The Timken Roller Bearing Company, Canton, Ohio; J. J. B. Rutherford, Mem. ASME, The Babcock & Wilcox Company, Beaver Falls, Pa.; A. B. Wilder, United States Steel Corporation, Pittsburgh, Pa.; and M. A. Cordovi, The International Nickel Company, Inc., New York, N. Y. 1959 ASME-AIEE National Power Conference paper (in type; to be published in **Trans. ASME—J. Engng. for Power**; available to July 1, 1960).

The ASME Research Committee on High Temperature Steam Generation has a program in progress to determine the performance characteristics of selected ferritic and austenitic tube materials when exposed to the action of steam at high temperatures and under pressure. The test units for this program are installed at the Philip Sporn Station of American Electric Power Service Corporation near Pomeroy, Ohio.

In this research, selected materials in tubular form are subjected to high-pressure steam (2000 psi) at temperatures of 1100 to 1500 F for time periods up to 36 months to determine the resistance to corrosion and creep, the effects of oxide films on thermal conductivity, the metallurgical stability, and the resistance to thermal shock. The test tubes are exposed to air on the outside and there is no temperature gradient across the tube wall. The present paper is concerned with the metallurgical aspects of this program.

Meramec 3 Steam Electric-Generating Unit..59—SA-27...By C. H. Rulfs, Mem. ASME, and J. K. Bryan, Mem. ASME, Union Electric Company, St. Louis, Mo. 1959 ASME Semi-Annual Meeting paper (multilithographed; available to April 1, 1960).

Meramec 3 comprises a 250,000-kw steam electric-generating addition to the Union Electric system in the St. Louis area.

This paper covers the high lights of the design from the viewpoint of economic-engineering considerations.

Basically, engineering must begin with a plant design having minimum cost, in dollars per kilowatt, to provide for reliable service together with safe operation, and with adequate provision for maintenance. Additional design features, in general those design features that increase investment cost but reduce operating cost, are then adopted as they are shown to be individually attractive.

In the case of Meramec 3, over-all project cost was in the order of \$40 million. The range in cost between a moderately efficient lowest-cost plant and a higher efficiency, higher-cost plant was in the order of \$2$^1/_2$ million. It is this latter amount that becomes the subject of engineering-economic analysis as the design is worked out. In making such an analysis, there must be established a number of factors, representing not eternal and immutable relationships, but best judgment at the particular time as applied to the particular utility and the particular project. And since these factors are different depending on economic, geographical, and other conditions, it follows that individual plant designs will be different.

Basic economic factors, such as fixed charge rate, fuel cost, load factor, thermal performance, and cost of unavailability are dealt with briefly.

Design features—size, steam conditions, number of feedwater heaters, deaerator, boiler feed pump, feedwater cycle, turbine generators, coal handling, instrumentation and control—are viewed largely from the standpoint of such economic considerations.

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Wood Industries

A Method of Proportioning Resin and Wax in Particle Board Manufacture..59—WDI-1...By J. E. Balint, Controls and Communications Company, Eugene, Ore. 1959 ASME Wood Industries Conference paper (multilithographed; available to July 1, 1960).

A precision automatic control system for the metering of resin and wax additives in a particle board process is described. The additives are controlled in proportion to the varying wood rate.

The use of electrical and electronic control facilitates the automatic recording of process variables in meaningful terms.

Inclusion of a percentage computer permits setting the control system in direct "per cent of additive solids" to wood-particle weight.

A correction factor for wood moisture content can be inserted to present records in the final desired form.

Operating results indicate that a high degree of accuracy has been achieved in proportioning the resin and wax with consequent savings of these items, and the operator has a permanent record of the actual proportions in the board.

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Maintenance and Plant Engineering

A New Search for Criteria of Equipment Reliability..59—SA-2...By I. J. Karassik, Mem. ASME, Worthington Corporation, Harrison, N. J. 1959 ASME Semi-Annual Meeting paper (multilithographed; available to April 1, 1960).

The growing complexity of modern technological processes and the greater need for uninterrupted operation requires a more thorough understanding of reliability concepts than ever before. A clarification of the concept of reliability and a discussion of the practical meaning of this concept are given.

This paper discusses a fundamental approach to reliability and to failure probabilities, classifying the latter into infant mortality, random failure, and wear-out. It examines the various possible causes of infant mortality in a typical piece of equipment, the boiler feed pump.

The paper examines the relationship between economy of operation, first costs, and reliability. The conclusions reached are that, despite the fact that reliability is an intangible asset, it deserves equal and even greater weight than those factors more commonly given consideration in the evaluation of equipment.

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Management

Developing Managerial Abilities..59—Mgt-1...By F. F. Bradshaw, Richardson, Bellows, Henry and Company, Inc., New York, N. Y. 1959 ASME-AIEE Engineering Management Conference paper (multilithographed; available to July 1, 1960).

The manager is a person who gets work done by other people with satisfaction to them and of a high quality in the face of difficulties and regardless of stress.

What are the characteristics common to the best managers? The characteristics seem to point to an individual who is more emotionally mature and relaxed, more apt to have time for planning and personnel actions, accessible to his subordinates, and unafraid in the presence of his superiors. He also knows the work to be managed, and has some good judgment of people, accessibility to people, and knowledge of the work; he does not find it hard to make a plan which will in actual effect be followed by others.

The capabilities of a potential manager should be developed in the on-the-job situation, allowing opportunity and incentive for the improvement of management skills.

and AISI 4140 or 4145 can be rendered insensitive to sulfide-stress cracking by tempering at a minimum temperature of 1150 F to develop yield strengths in the range 75,000 psi minimum—90,000 psi maximum. Specially treated N-80 casing is not now available and, to avert sulfide-stress cracking failures in potentially susceptible N-80 materials, it is necessary to exclude the well fluids from the casing-tubing annulus. This can best be accomplished by using bottom-hole packers and by insuring against leaks in the tubing joints.

2 Critical components of wellhead equipment that require materials with hardnesses of Rockwell C 30 or greater, should be made of K-Monel which, under the conditions encountered in sour-condensate well service, is immune to cracking.

3 Equipment that is fabricated by welding or which may be repaired by welding should be thermally processed after welding to limit hardness to 225 Bhn maximum. For carbon steels, this can be accomplished by tempering at 1150 F; because of the variable response of alloy steels to tempering, it is not possible to specify the temperature at which the maximum hardness requirement will be achieved. Therefore the equipment supplier should establish the minimum tempering temperature required to properly condition the particular type of steel that may be involved.

Specially Designed Equipment for Engineering Test Laboratory..59—Pet-25... By C. E. Anderson, Mem. ASME, and R. A. Gulick, W-K-M Division of ACF Industries, Inc., Houston, Texas. 1959 ASME Petroleum Mechanical Engineering Conference paper (multilithographed; available to July 1, 1960).

In 1956, it was decided that the Engineering Department had outgrown its testing laboratory in the W-K-M plant at Missouri City. This laboratory was required to evaluate improvements to the three existing lines of products and for the experimental testing of new product lines. The current products fell into basically three categories: gate valves, plug valves, and cast fittings, and closures. Early in the design of this testing facility, it became evident that, in order to comply with the basic requirements and to remain within the budgetary limitations of approximately $75,000, it would be necessary to adapt and modify commercially available components. It is felt that the solutions arrived at may be of interest and assistance to other companies faced with similar problems.

This paper covers the design of special testing equipment for the engineering physical testing laboratory including a manually controlled system capable of 100,000-psi pressure, three automatically controlled pressure systems of 1500, 3000, and 15,000-psi capacities, a strain-gage system designed to digitally log apparent stresses, and supplementary equipment.

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Lubrication

Hydrostatic Gas Bearings..59—Lub-1... By J. H. Laub, California Institute of Technology, Pasadena, Calif. 1959 ASME-ASLE Lubrication Conference paper (in type; to be published in **Trans. ASME—J. Basic Engng.**; available to Aug. 1, 1960).

Orifice-regulated hydrostatic gas bearings offer significant advantages for instrument applications. In particular, gimbal bearings for inertial-guidance systems can be designed with negligible starting torque and high stiffness, and for operation at extreme temperatures.

A literature search revealed the lack of convenient and accurate data for the design of hydrostatic gas bearings of various configurations, taking into consideration the effects of compressibility, which cannot be neglected at higher pressures.

Based on Euler's equation, expressions for the significant parameters, i.e., pressure profile, gas-flow rate, gap height, and load-carrying capacity of pad and step bearings, are developed. These parameters yield results which are in excellent agreement with experimental data. The test fixture incorporates pneumatic loading by means of a bellows-suspended piston which is prevented from cocking by an air bearing.

A Sommerfeld Solution for Finite Bearings With Circumferential Grooves..59—Lub-4... By J. V. Fedor, Assoc. Mem. ASME, Naval Ordnance Laboratory, Silver Spring, Md. 1959 ASLE-ASME Lubrication Conference paper (in type; to be published in **Trans. ASME—J. Basic Engng.**; available to Aug. 1, 1960).

A method of solution is developed that circumvents the algebraic complexity in the solution of Reynolds differential equation applied to full journal bearings.

The method leads to equations for journal-bearing characteristics that are in finite form.

Salient features of the complete-oil-film solution are: As the eccentricity ratio b approaches 1, the load capacities of all finite gearings approach that of the infinite bearing; also, the friction curve intercept, $(r/c)f$, is 1 for all finite bearings when b equals 1. Results are compared with calculated values published by Muskat and Morgan for $0 < b < 0.6$.

Excellent agreement is found throughout the compared range.

Power

Montrose Steam-Electric Station Operating Experience..59—Pwr-2... By G. A. Myers, Mem. ASME, Kansas City Power & Light Company, Kansas City, Mo. 1959 ASME- AIEE National Power Conference paper (multilithographed; available to July 1, 1960).

The first unit, 175,000-kw net capability, of Kansas City Power & Light Company's Montrose steam-electric plant, was placed in commercial operation July 16, 1958. Montrose is a mine-mouth plant located in Henry County near Clinton, Mo., some 60 air miles south and east of Kansas City. The largest of the known Missouri coal deposits, that can be economically mined, are located in Henry County area near the plant.

This area contains approximately 70 million tons of mineable coal, sufficient to justify the mine location of a power station developed in accordance with system requirements to a maximum of 525,000-kw net capability by 1963 or 1964. The three units planned will burn 66 million tons of coal at a 73 per cent load factor during a 40-year period or 120 machine years.

Contracts with Peabody Coal Company will dedicate a large portion of the Henry County coal reserves to the Kansas City Power & Light Company.

The coal company will deliver the coal to the plant unloading hoppers in railroad cars furnished by the power company at a cost of $12^{1}/_{2}$ cents per ton, a 92 per cent reduction in freight costs when compared with the rate of $1.62 per ton to Kansas City from the Montrose area.

The use of raw coal eliminates the preparation costs. The reduction in freight and preparation costs results in a fuel cost per million Btu approximately 24 per cent less than at Kansas City. The magnitude of possible savings by using raw coal rather than washed coal at the mine-mouth plant justified use of raw coal. Furthermore, using raw coal would, in effect, add 25 to 30 per cent to the tonnage of economic mineable coal in the area close to plant with a corresponding increase of about 20 per cent in total heat recovery. Therefore the use of raw coal would make it possible to burn low-cost fuel for a one-fifth longer period of time as compared with washed coal.

Initial experience of operating the Montrose plant is presented. Data are presented on condensing water, turbogenerators, the condenser, steam generator, boiler circulating pumps, pulverizers, coal handling, ash removal, freeze protection, plant performance, and operating manpower.

for maximum performance is only one factor requiring intense managerial attention.

Since the weapon must come into operational use in time to provide a competitive challenge to the best that a potential enemy can offer, it faces a rigid time schedule. Moreover, because each military program must continually justify its share of a tight Federal military budget, it comes under the strictest kind of cost control. These three factors—performance, schedule, and cost—continually demand difficult decisions. Many times a gain in one area necessarily means a loss in another. Thus a high degree of managerial judgment is constantly required in order to develop a product that keeps faith with all of the original requirements.

A deliberate and continuing program for developing engineer-managers has thus become one of the vital requirements for a company engaged in important defense contracting.

Decision Making in Engineering..59—Mgt-6... By W. T. Nichols and R. E. Heitman, Arthur D. Little, Inc., Cambridge, Mass. 1959 ASME-AIEE Engineering Management Conference paper (multilithographed; available to July 1, 1960).

New techniques associated with operations research, advanced mathematics, and computers are vital forces in engineering decision making.

Applications already are numerous and varied; new ones constantly appear.

Fantastic computer speeds allow use of complex mathematical methods for accurate solution of intricate design problems. Previous concepts of what is and is not practical must be revised.

Through simulation and mathematical models, years of actual or hypothetical operations can be quickly reproduced. Computers can make automatic decisions and program themselves, and may one day compete with man in purely intellectual decisions.

Engineering Programs for New Frontiers..59—Mgt-9... By G. P. Sutton, Mem. ASME, Advanced Research Projects Agency, Department of Defense, Washington, D. C. 1959 ASME-AIEE Engineering Management Conference paper (multilithographed; available to July 1, 1960).

For many years the Department of Defense has fostered, in a major way, research and development in support of programs for the defense of the United States.

The Advanced Research Projects Agency, ARPA for short, is a new organization for the management of advanced research and development projects. Its aims are to leap-frog the state of the art, pushing forward the frontiers of knowledge to conceive, improve, and advance new weapons systems.

This paper describes some of the projects that have been sponsored or spawned by the Advanced Research Projects Agency and employs them as examples of engineering programs of advanced technology. Observations on problems in engineering management are noted with the hope that these remarks will be useful.

Planning and Control in Engineering Management..59—Mgt-7... By N. J. Ream, Lockheed Aircraft Corporation, Burbank, Calif. 1959 ASME-AIEE Engineering Management Conference paper (multilithographed; available to July 1, 1960).

The increasing complexity of engineering systems makes the need for integrated engineering management greater and greater. With the ever-growing state of the art, there are more technical and engineering-management decisions required than in the past. As a result, the cost and uncertainty of the engineering process are increasing.

In this paper, over-all planning and control problems of management are treated. These problems are then related specifically to the management of engineering and scientific operations.

Within the proper management climate, major improvements can be made in the management of engineering and scientific efforts. The improvements are mandatory for these are important segments of our national security effort and our economy.

Engineering and scientific efforts are not entirely creative and unpredictable. Many of its segments are repetitive and measurable, and can be improved with large pay-offs in efficiency, even without measurement of the more creative aspects.

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Applied Mechanics

Stresses in a Circular Cylinder Having an Infinite Row of Spherical Cavities Under Tension..59—APMW-9... By Akira Atsumi, Tohoku University, Sendai, Japan. 1959 West Coast Conference of the ASME Applied Mechanics Division paper (in type; to be published in **Trans. ASME—J. Appl. Mech.;** available to July 1, 1960).

A problem of finding the stresses in an infinite circular cylinder having an infinite row of spherical cavities of the same size under axial tension is studied theoretically.

Maximum stresses in the cylinder are calculated by a perturbation method, in each case the radius of the cavity and the distance between the centers of the neighboring cavities being varied.

From consideration of the results obtained, some conclusions are made regarding the effects of the surface and the cavities on the stresses.

The Fundamental Frequency of a Thin, Flat Circular Plate Simply Supported Along a Circle of Arbitrary Radius..59—APMW-10... By R. Y. Bodine, University of Wisconsin, Madison, Wis. 1959 West Coast Conference of the ASME Applied Mechanics Division paper (in type; to be published in **Trans. ASME—J. Appl. Mech.;** available to July 1, 1960).

The fundamental transverse frequency is determined for a thin, flat, circular plate simply supported along a circle of arbitrary radius.

It is shown that there are three support locations which coincide with "classical" plate solutions.

The dimensionless frequency is plotted against the ratio of the support radius and outer-edge radius, showing the frequency variation with support location.

The maximum frequency occurs when the support is located at the diameter of the first nodal circle of a free-edge plate.

The Melting of Finite Slabs..59—APMW-11... By T. R. Goodman and J. J. Shea, Allied Research Associates, Inc., Boston, Mass. 1959 West Coast Conference of the ASME Applied Mechanics Division paper (in type; to be published in **Trans. ASME—J. Appl. Mech.;** available to July 1, 1960).

An approximate method, known as the heat-balance integral, is used to determine the melting rate of a finite slab which is initially at a uniform temperature below the melting point.

The slab is acted upon by a constant heat input at one face and has its other face either insulated or kept at its initial temperature.

The first three terms of series solutions in an intrinsically small parameter are obtained for the time histories of melting and the temperature distribution in the slab.

The Free Vibrations of Grillages..59—APMW-12... By J. P. Ellington, United Kingdom Atomic Energy Authority, Risley, Warrington, England; and H. McCallion, University of Nottingham, Nottingham, England. 1959 West Coast Conference of the ASME Applied Mechanics Division paper (in type; to be published in **Trans. ASME—J. Appl. Mech.;** available to July 1, 1960).

In a previous paper the authors discussed the static bending moments and deflections of a simply supported beam grillage subjected to concentrated loads applied at the nodes, a solution being found through the calculus of finite differences. Now, in a similar manner, the

The Philosophy of Engineering Management..59—Mgt-3... By J. L. Young, Mem. ASME, United States Steel Corporation, Pittsburgh, Pa. 1959 ASME-AIEE Engineering Management Conference paper (multilithographed; available to July 1, 1960).

To make his maximum contribution to society, an engineer must be interested in his company's growth as well as his own. He and his employer both must work within a climate in which the engineer can assume his professional responsibilities and the employer can achieve the profitable utilization of engineering skills.

Philosophy of engineering management should also take into consideration the human characteristics which influence a man's choice of engineering as his career.

These characteristics, which typify engineering aptitude, are curiosity, imagination, and a noble discontent with things as they are.

Implicit in the individual characteristics named is the need for management to recognize and respond to men who have such personalities and such professional pride in their skill. Basically, it is the three R's which are important generally in management but which apply particularly to engineers: Recognition, responsibility, and remuneration.

Yet, management of engineers is far more than a simple matter of working effectively with curious, imaginative, and restless individualists. The engineer manager must accomplish his aims, as indeed any other manager must, through effective organization. Proper management must include the things which weld individualists into an efficient team. And because this involves complex human relationships, the organization part is one of the most intriguing, the most sensitive, and probably the most pertinent part.

The manager of a team of engineers must be a competent organizer to get the best results from competent people. Usually, his own experience as an engineer has taught the manager the importance of working with and through the individual and team capabilities of his associates. Doing this obviously calls for proper communicating.

The flow of information must be adequate, timely, and of such depth that all concerned may acquire the necessary knowledge and understanding to perform their jobs effectively.

Effective communications, then, is a must in engineering management.

Whether a group of engineers operate effectively as a team or not often depends on the quality of communications.

New Methods of Engineering Decontrol..59—Mgt-2... By H. H. Goode, University of Michigan, Ann Arbor, Mich. 1959 ASME-AIEE Engineering Management Conference paper (multilithographed; available to July 1, 1960).

The needs of our society demand a more efficient use of the engineering man-hour, that is, more engineering per engineer.

A thesis is set forth which maintains that it is possible to achieve greater engineering production through the removal of routine tasks from the engineer's job. It is suggested that the development of new theoretical tools as well as new equipment will make this possible in engineering as it has in administrative planning, research, business data processing, and the like.

Such tools as linear programming, queueing theory, human factors research, decision theory, information theory, high-speed computers, high-speed communications nets, and such, are available to free the engineer for more creative work.

Development of Engineering Managers in Governmental Organizations..59—Mgt-4... By B. S. Grant, Department of Water and Power, City of Los Angeles, Calif. 1959 ASME-AIEE Engineering Management Conference paper (multilithographed; available to July 1, 1960).

A number of different factors are involved in governmental organizations and operations connected with governmental organizations.

Emphasis is placed on the particular fields in which the engineering manager may cope with unusual management problems. A summary list of qualities which are useful to the engineer in such a situation follows:

Develop good understanding of legal philosophies and terminology. Ingenuity in collaborating with attorneys to find alternate methods of accomplishing worthy goals that are impossible under outmoded laws is a most desirable attribute.

Develop ability to sell an idea to the citizens of a community. Participation in community activities outside of his utility position will prove of great aid in the event he needs to sell an issue to the voters.

Develop the technique of self-expression and making oral presentations. Careful preparation and outlining of the subject to be presented so as to keep presentations brief and to the point are an essential supplement to the ability to express your thoughts orally.

Develop ability to tactfully direct conversations and discussions so as to keep them on the subject matter and at the appropriate organization level. When the directors tend to usurp the duties of the manager he will need to exercise courteous but firm strategy to lead them back to the policy-making level.

Develop a breadth of political understanding while being a good citizen without party affiliation.

Develop ability to analyze historical data and to project trends into the future based upon an understanding of natural phenomena.

Develop ability to organize a large utility operation with personnel selected under a civil-service jurisdiction.

Develop an understanding of the importance of good management of a business on the cost of money needed to run and build it with special reference to the municipal utility.

Develop an understanding of the importance of good public relations and the methods of obtaining the public good will; and the ability to instill in the minds of every employee the necessity of establishing and maintaining good public relations.

Some Aspects of Control of the Engineering Function..59—Mgt-8... By J. S. Sayer, Mem. ASME, E. I. du Pont de Nemours & Company, Wilmington, Del. 1959 ASME-AIEE Engineering Management Conference paper (multilithographed; available to July 1, 1960).

A most effective tool for improving control of the engineering function is improved information and its manipulation by formal disciplined means. A large part of the engineering control problem becomes one of properly processing large volumes of continually changing technical information, as well as smaller volumes of normal cost and personnel data.

Whatever the data and information, they should contribute to engineers or managers arriving at sound decisions.

Modern documentation principles for effective storage and retrieval of information are touched on, and one case, embracing a new technique of work planning and scheduling, is presented for "information manipulation by formal disciplined means."

Development of Engineer-Managers in Defense Industry..59—Mgt-5... By J. L. Atwood, North American Aviation, Inc., Los Angeles, Calif. 1959 ASME-AIEE Engineering Management Conference paper (multilithographed; available to July 1, 1960).

Nowhere in recent years has there been a sharper increase in the demand for engineer-managers than in the United States defense effort. The astounding recent technological achievement has put an enormous new demand on engineering management. Integration of subsystems frequency equations and modal shapes of such a grillage are found for various boundary conditions.

Although several studies have been made of static loading of grillages, apart from the method of replacing the grillage by an equivalent anisotropic plate, the only work on the vibrations of such systems seems to be that of Cox and Denke, who have shown how to cast the problem into matrix form suitable for use with a digital computer.

The system considered in this paper is made up of two orthogonal sets of beams attached at the nodes so that no moments, bending or torsional, are transmitted from one set to the other. The mass of the beams and associated plating or covering is taken as lumped at the nodes, so that there is an equal point load at each node. Taking the bending moments and deflections under each load as unknown, the equations of continuity and equilibrium taken with appropriate boundary conditions furnish the required frequency equations.

On Stress-Strain Relations and Strain-Energy Expressions in the Theory of Thin Elastic Shells..59—APMW-13... By J. K. Knowles, California Institute of Technology, Pasadena, Calif.; and Eric Reissner, Mem. ASME, Massachusetts Institute of Technology, Cambridge, Mass. 1959 West Coast Conference of the ASME Applied Mechanics Division paper (in type; to be published in **Trans. ASME—J. Appl. Mech.;** available to July 1, 1960).

The stress-strain relations of Flügge and Byrne for thin elastic shells are inverted to express strain quantities, and therewith the strain energy, in terms of stress resultants and couples.

In this form, and upon omission of terms which are small of order h^2/R^2, the stress-strain relations and the strain-energy expression are shown to be simply related to corresponding results of Trefftz.

The strain-energy formula of Trefftz is generalized to arbitrary orthogonal middle surface co-ordinates.

On the Propagation of Shock Waves in a Nonhomogeneous Elastic Medium..59—APMW-17... By Eli Sternberg, Assoc. Mem. ASME, and J. G. Chakravorty, Brown University, Providence, R. I. 1959 West Coast Conference of the ASME Applied Mechanics Division paper (in type; to be published in **Trans. ASME—J. Appl. Mech.;** available to July 1, 1960).

This paper is concerned with the propagation of shock waves in a nonhomogeneous isotropic plate of infinite extent and arbitrary thickness.

The plate has a transverse cylindrical hole at which uniform shearing tractions are suddenly applied and thereafter steadily maintained; the body is otherwise free from loading.

It is assumed that the shear modulus of the material is proportional to an arbitrary—not necessarily integral—power of the radial distance from the axis of the hole, while no restriction is placed upon the (continuous) radial variation of Young's modulus.

The solution obtained, which is discussed in detail, constitutes a generalization of results reached by Goodier and Jahsman, who considered the present problem for a homogeneous medium.

Effect of the Wall on Two-Phase Turbulent Motion..59—APMW-18... By S. L. Soo, Assoc. Mem. ASME, University of Illinois, Urbana, Ill.; and C. L. Tien, University of California, Berkeley, Calif. 1959 West Coast Conference of the ASME Applied Mechanics Division paper (in type; to be published in **Trans. ASME—J. Appl. Mech.;** available to July 1, 1960).

Stationary solution on the effect of a wall on two-phase (solid particles in gas) turbulent motion shows that the intensity of motion of solid particles is affected by the presence of the wall and the distribution of turbulent intensity of the stream near the wall.

The intensity of motion of solid particles can be significantly higher than the turbulence intensity of the mean stream.

These modifications are consequences of Bernoulli force acting between the wall and the particle.

Bending of Isosceles Right Triangular Plates..59—APMW-19... By H. J. Fletcher, Brigham Young University, Provo, Utah. 1959 West Coast Conference of the ASME Applied Mechanics Division paper (in type; to be published in **Trans. ASME—J. Appl. Mech.;** available to July 1, 1960).

Two methods are presented for the solutions of problems of an isosceles right triangular plate bent by arbitrary transverse loads.

One method makes use of a concentrated diagonal load on a square plate.

The other uses an antisymmetric load on a square plate.

A numerical solution is given for the case of clamped hypotenuse and simply supported legs.

A table is given indicating how to solve fifteen of the possible eighteen problems in which an edge is free, clamped, or supported.

Boundary-Layer Solution for a Flow in a Diverging Passage Having a Swirl Component..59—APMW-14... By M. A. Sinbel, General Petroleum Authority, Cairo, Egypt. 1959 West Coast Conference of the ASME Applied Mechanics Division paper (in type; to be published in **Trans. ASME—J. Appl. Mech.;** available to July 1, 1960).

A solution is given to estimate the boundary-layer thickness owing to translational and rotational motion. The solution is an attempt to derive the boundary-layer equations when the main stream possesses both swirl and axial velocity.

The development of the boundary layer in a conical duct is influenced by centrifugal action in addition to the pressure and viscous forces.

The boundary-layer momentum integral equations are derived and presented herein for a set of spherical polar co-ordinates.

The solution has been carried out for laminar flow.

A turbulent form of the solution can be obtained by the introduction of the mixing-length theory.

A numerical solution is carried out to make a comparison between the estimated and actual measured values.

Transverse Flexure of a Semi-Infinite Thin Plate Containing an Infinite Row of Circular Holes..59—APMW-15... By O. Tamate, Tohoku University, Sendai, Japan. 1959 West Coast Conference of the ASME Applied Mechanics Division paper (in type; to be published in **Trans. ASME—J. Appl. Mech.;** available to July 1, 1960).

The problem of finding stress resultants in a semi-infinite plate under plain bending and containing an infinite row of equal and equally spaced circular holes is discussed on the basis of the Poisson-Kirchhoff theory of thin plates.

A method of perturbation is adopted for the determination of parametric coefficients included in the solution.

The maximum bending moments occurring on the rim of the hole across the minimum section are calculated for several cases and shown in graphs, from which the mutual interference of adjacent boundaries will be informed.

Plastic Stress Concentration at a Circular Hole in an Infinite Sheet Subjected to Equal Biaxial Tension..59—APMW-16... By Bernard Budiansky, Mem. ASME, and O. L. Mangasarian, Harvard University, Cambridge, Mass. 1959 West Coast Conference of the ASME Applied Mechanics Division paper (in type; to be published in **Trans. ASME—J. Appl. Mech.;** available to July 1, 1960).

With the use of J_2 deformation theory, the stress-concentration factor at a circular hole in an infinite sheet of strain-hardening material subjected to equal biaxial tension at infinity is found for a variety of representative materials.

The analysis exploits a transformation which permits the calculation of the stress-concentration factor without determining the stress distribution in the sheet.

Subsequent calculations reveal that, for a monotonically increasing applied stress, the stress history at all points in the sheet is nearly radial.

Vibrations and Waves in Elastic Bars of Rectangular Cross Section..59—APMW-23... By R. D. Mindlin, Mem. ASME, Columbia University, New York, N. Y.; and E. A. Fox, Assoc. Mem. ASME, Rensselaer Polytechnic Institute, Troy, N. Y. 1959 West Coast Conference of the ASME Applied Mechanics Division paper (in type; to be published in **Trans. ASME—J. Appl. Mech.;** available to July 1, 1960).

An exact solution of the equations of elasticity is found for a family of modes of vibration, or waves, in an infinite bar of rectangular cross section for certain ratios of width to depth.

The solution is composed of coupled dilatational and equivoluminal waves, and the four faces of the bar are free of traction.

The Solution of Elastic Stability Problems With the Electric Analog Computer..59—APMW-20... By J. H. Shields and R. H. MacNeal, Computer Engineering Associates, Inc., Pasadena, Calif. 1959 West Coast Conference of the ASME Applied Mechanics Division paper (in type; to be published in **Trans. ASME—J. Appl. Mech.;** available to July 1, 1960).

An application of electric analog computing methods to the analysis of elastic stability problems is described.

An electrical circuit is first devised which satisfies a general differential equation that is frequently encountered in the literature of elastic stability.

This circuit, composed of inductors, capacitors, transformers, and current generators, is then used to obtain solutions for several classical column, framework, and plate-stability problems.

Heat Transfer for Laminar Flow in Ducts With Arbitrary Time Variations in Wall Temperature..59—APMW-21... By Robert Siegel, Assoc. Mem. ASME, NASA, Lewis Research Center, Cleveland, Ohio. 1959 West Coast Conference of the Applied Mechanics Division paper (in type; to be published in **Trans. ASME—J. Appl. Mech.;** available to July 1, 1960).

An analysis is made for laminar forced-convection heat transfer in a circular tube or a parallel plate channel whose walls may undergo arbitrary time variations in temperature.

The time-varying process can begin from an already established steady-state situation with heat transfer taking place, or the fluid and walls can be initially at the same uniform temperature.

The fluid velocity distribution is fully developed and unchanging with time. At any instant during the transient the wall temperature is spatially uniform, that is, all portions of the wall simultaneously undergo the same temperature-time variation.

The greater part of the analysis is concerned with the response to a step change in wall temperature, and the time required to reach steady state is given for this type of transient. Then the results are generalized to apply for arbitrary variations with time.

ASME TRANSACTIONS

The October, 1959, issue of the Transactions of the ASME—*Journal of Engineering for Power* (available at $1.50 per copy to ASME Members; $3 to nonmembers)—contains the following:

Journal of
ENGINEERING FOR POWER
Volume 81 • Series A • Number 4

361 The Aerodynamic Approach to Furnace Design, by J. H. Chesters. (58-A-72)

371 Use of Flow Models for Boiler-Furnace Design, by R. W. Curtis and L. E. Johnson. (58-A-120)

380 Use of Models for Studying Pulverized-Coal Burner Performance, by G. C. Whitney. (58-A-95)

383 Basic Principles of Combustion-Model Research, by A. A. Putnam and E. W. Ungar. (58-A-73)

389 A New Performance Criterion for Steam-Turbine Regenerative Cycles, by J. Kenneth Salisbury. (58-A-205)

403 Power Test Code Thermometer Wells, by J. W. Murdock. (58-A-176)

417 Flow-Induced Noise in Heat Exchangers, by A. A. Putnam. (58-A-103)

423 The Effect of Fuel Types and Admission Method Upon Combustion Efficiency, by H. N. McManus, Jr., W. E. Ibele, and T. E. Murphy. (58-A-128)

428 Torsion of a Prismatical Bar Whose Section Is a Crescent, by F. Sisto. (59-GTP-6)

433 The Transient Response of Gas-Turbine-Plant Heat Exchangers—Regenerators, Intercoolers, Precoolers, and Ducting, by A. L. London, F. R. Biancardi, and J. W. Mitchell. (59-GTP-5)

449 Stresses in Hollow Cylinders Due to Asymmetrical Heat Generation, by Harry Kraus and George Sonnemann.

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COMMENTS ON PAPERS

Numerical Control—Benefits and Economies

Comment by W. E. Brainard[1]

THIS paper[2] is a welcome confirmation of the wise planning on the part of the Air Materiel Command that led to the procurement of a considerable quantity of numerically controlled machine tools. The intelligent and aggressive work of the Aircraft Industry Association and that of individual companies such as Boeing has enabled these modern manufacturing machines to make significant contributions in both cost savings and product quality as this paper so skillfully points out.

A most valuable consequence to the author's paper is to be anticipated. The thinking man will reread, study, and reflect. He will have questions and diligently will seek their answers. Many industries which have been observing the advent of numerical control with casual interest will seriously evaluate the potentialities of this newcomer—and, thereby, generate a keen awareness of its vital importance.

Comment by J. M. Rhoades[3]

The paper[2] concurs with our evaluation of the performance of continuous contouring control by users who have undertaken adequate training programs.

The complexity of parts machined by this type control is limited only by the computer programming worked out to date. The IBM-704 computer can also be used for this purpose.

The 0.003-in. accuracy of the large parts described can only be maintained with a small change in temperature over the test period.

A 10-ft-long aluminum part will change length approximately 0.0015 in. per deg F. Some of the larger machines in factory locations with poor temperature control can grow 0.020 in. or more from early morning until midafternoon.

Comment by W. L. McCann[4]

The paper[2] presents evidence of predictions made at M.I.T. and at Giddings and Lewis that the airframe manufacturing field would be the first to make use of numerical path control because of complicated shapes that basically have numerical definition. To go back into the history of numerical control and the aircraft industry, it must be pointed out that early in 1955, the Air Materiel Command was at the point of releasing contracts to machine-tool builders for skin-milling machines and profile-milling machines that were to be controlled by template and tracing servomechanisms.

In June of that year, Giddings and Lewis demonstrated the use of numerical control to the Air Force and succeeded in influencing the procurement of these machines as numerically controlled rather than template controlled machines. After a further specific request by the Air Materiel Command to produce a portion of a wing skin by numerical control, the contracts for machines were modified to include numerical control. At that time, programming methods were restricted to the use of desk calculators and were quite tedious. However, it was apparent that great savings could be made; and Giddings and Lewis proclaimed, as had M.I.T. Servomechanisms Laboratory officials before them, that the first acceptance of numerical control in industry would be in airframe manufacturing and would be extremely successful. The paper under discussion certainly brings out the correctness of the predictions made.

It may be interesting to note at this time that the machine control which bears General Electric's name had its inception at Giddings and Lewis. A small skin mill was built for the purpose of developing the G.E. Record-Playback machine control. The machine was equipped to be controlled by templates and electric selsyn-type tracer, recording selsyn phase modulated signals on magnetic tape for playback to control the machine. During the June, 1955, demonstrations of numerical control on the same machine, the Record-Playback feature was performed and compared with the same cuts made with numerical control through the same magnetic tape unit using identical signals. It is sufficient to say that the Record feature was never used again on the machine and numerical control has taken over completely, and the machine control has continued to be the control used with the Giddings and Lewis Numericord Control System.

At Boeing's Wichita plant, the author indicates that there are two numerical control systems being used. One is the Bendix System controlling three Kearney and Trecker profilers, and the Giddings and Lewis Numericord System which controls the three Kearney and Trecker skin mills and the Morey profiler. I sincerely congratulate Boeing for having done a thorough job in preparing for numerical control months before accepting the first equipment. Close attention to programming methods and the development of programming routines and short-cut computer language has made it possible to build-up a record including reduction of lead time, improved quality, and reduced tooling costs. A thorough training in maintenance of new and complicated equipment has been a big factor, and Boeing's decision to learn at the machine-tool builder's plant as well as the system-builder's plant turned out to be a wise one.

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[1] Chief Engineer, Servo Machine Tool Division, Kearney & Trecker Corporation, Milwaukee, Wis.

[2] W. D. Beeby, "The Operating Experience on Aircraft Production," MECHANICAL ENGINEERING, vol. 81, May, 1959, pp. 66–67.

[3] Senior Development Engineer, Development Engineering Unit, Specialty Control Department, General Electric Company, Waynesboro, Va.

[4] General Engineering Manager, Giddings & Lewis Machine Tool Company, Fond du Lac, Wis. Mem. ASME.

The development of programming for numerical control continues at Giddings and Lewis as it does in many other centers, including both Boeing plants, to make machining of complicated parts in two and three dimensions just a matter of feeding relatively simple information into a computer. The end result is a tape, either magnetic or paper, to completely control the machine tool.

The presentation of this paper brings a great deal of gratification to those people who have put so much effort into bringing numerical control into reality. I believe that there is a great amount of progress to be made in both machines and systems used in numerical control, but this represents concrete growth of a new concept now some nine years from the time that M.I.T. began work under sponsorship of the Parsons Corporation and the Air Force in their Servomechanisms Laboratory.

Comment by H. P. Grossimon[5]

First, according to this paper[2] Boeing should be commended on their excellent planning for the arrival of numerical control equipment. We at Concord Control know well how good a job they have done from the results they have achieved with our equipment—the Giddings and Lewis Numericord Director. Such prior planning is extremely important to the success of numerical control in a large aircraft plant. The numerical control concept is new and it is complex. Prior planning determines to a large extent whether a given installation will be an immediate success, a temporary failure, or even a permanent failure.

Secondly, I would like to expand on one of the benefits of numerical control that the author touched on: Savings in tooling. As he pointed out, the greater flexibility of a numerically controlled machine allows most parts to be machined with fewer fixtures. But the effect of numerical control on tooling is even more pronounced. The machine control tape itself is a new type of tooling. It can be produced quickly and economically, changed easily, stored compactly for an indefinite period, and, in the case of magnetic tape, it can be erased and reused. Because most of the information required to make the part is stored on the tape, reruns of parts made months or years previously can be handled easily. This is a significant factor in view of today's defense picture. In conventional methods reruns usually require an initial period of learning similar to that encountered on the first run, during which optimum techniques have to be redeveloped and during which machining errors tend to be high. Tape tooling stores these techniques for immediate reuse. Advantages gained in the learning period of the first run are permanently recorded. In addition, tape tooling has allowed various aircraft companies to co-operate in the production of parts. Much consideration is being given to the problem of compatibility in numerical control. The very existence of tape tooling has allowed the aircraft industry to achieve much of the results hoped for in compatibility considerations. Because the information stored on tape is in a highly organized form it has been relatively easy for one aircraft company to produce the tape tooling for another company or for a subcontractor. Tape can be shifted from one plant to another relatively easily. Again, this advantage of numerical control in light of defense requirements is significant.

From Engineer to Administrator

Comment by D. C. Purdy[6]

This paper[7] implied a viewpoint on engineering administration which is becoming all too prevalent, and which will lead to trouble if ever completely adopted in an engineering organization.

To make my point, I find it necessary to paraphrase the author's article to bring out his attitudes. It would go something like this:

Engineering administrators (i.e., project leaders, group leaders, and the like) are different from "technical" engineers. There is no necessary correlation between a man's ability as an engineer and as an administrator. Administrators—including project leaders, and so on, are more concerned with the principles and techniques of management than they are with engineering. Therefore it makes sense to select men for administrative positions in about a year after leaving college, and give them special training as administrators.

The fault in this attitude is that the basic function of the personnel discussed by the author is leading engineers. The administrative and management functions are merely techniques to get the basic job—engineering—done. A project or group leader cannot fulfill his function until he has demonstrated his engineering ability and earned the respect of his fellow engineers.

Perhaps, the confusion arises because the kind of engineering done by a leader is different from that done by the fellow who does the actual design or calculation. Many lead engineers are poor at the mechanics of their professions. Their particular talents are more esoteric. They have a "feel" for engineering. They can balance factors; espy problems; foresee solutions. This is still engineering. The man who sets up the problem is as much an engineer as the man who solves it.

If the attitude that administrators and engineers are two different kinds of people, who can be separated after a short while, is adopted, the ability of the administrator to lead will be destroyed. An engineer will not willingly work for a man he cannot respect. He cannot respect a man who has not demonstrated his engineering ability. In addition, by affecting such a separation early, the further incentive of an engineer to improve himself will be absent.

Author's Closure

It has been demonstrated by surveys and resulting literature that (technical) engineers and (engineering) administrators are "two different kinds of people." This does not mean, however, that one individual cannot possess or acquire, in adequate quantities, the traits and abilities of both. Rather, as I see it, it is a matter of degree.

Certainly if the individual who excels in "technical" engineering also possesses or acquires the requirements of an administrator, he is the obvious choice for an engineering administration position. Unfortunately, such an individual is rare indeed, and it becomes an economic necessity to compromise—to select the individual who measures up most nearly to the ideal. The paper[7] set forth a procedure for doing just this.

I do not share the alarm of Mr. Purdy—"the ability of the administrator to lead will be destroyed"—"an engineer will not willingly work for a man he cannot respect. . .who has not demonstrated his engineering ability"—"the further incentive of an engineer to improve himself will be absent."

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[5] Vice-president, Concord Control, Inc., Boston, Mass.

[6] Assoc. Mem. ASME.

[7] O. J. Sizelove, "Developing From an Engineer to an Administrator," MECHANICAL ENGINEERING, vol. 81, April, 1959, pp. 54–55.

As Mr. Purdy says, "the man who sets up the problem (and I would add, the one who manages it) is as much an engineer as the one who solves it." He is respected for this demonstrated administrative and engineering ability. Thus his ability to lead is enhanced, not destroyed. Contrary to Mr. Purdy's view, once an engineer knows that he is more likely ultimately to excel in either technical or "administrative" work, it would appear that he has even greater incentive to further his knowledge accordingly. This has been evident in the engineering graduate schools for a decade or more.

However, I do not feel that the aforementioned completely dismisses the fears expressed by Mr. Purdy. Rather, these, and other problems to come in our expanding economy, must be detected, analyzed, and solved by alert management.

All the administrative techniques must be under constant surveillance.

O. J. Sizelove.[8]

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[8] Professor and chairman, Department of Management Engineering, Newark College of Engineering, Newark, N. J. Mem. ASME.

Notes on
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REVIEWS OF BOOKS

Steam Turbines

Steam-Turbine Performance and Economics

By Robert L. Bartlett with contributions by J. E. Mulder and R. C. Sheldon, Large Steam Turbine-Generator Department, General Electric Company. Published by McGraw-Hill Book Company, Inc., New York, N. Y. Copyright 1958 by the General Electric Company, Inc. Cloth, 6 × 9 inches. Foreword by Glenn B. Warren, vice-president and consulting engineer, Turbine Division, General Electric Company; 218 figs., 21 tables, 2 appendixes, literature cited, index, xiii and 317 pp., $12.50.

Reviewed by Ralph Scorah[1]

The author of this book has had access to the full resources of the Large Steam Turbine-Generator Department of the General Electric Company. He has had the good fortune to be associated with such men as Elston, Harris, Knowlton, Warren, Salisbury, Schabtach, Sheppard, Hegetschwelier, et al. This collective authority is indeed impressive and can be matched by only a few other manufacturers. As a consequence of this central source and design philosophy, the performance-calculation system presented in this book has been derived for steam turbines of wheel and diaphragm design. However, for turbines based on different design philosophies, there will be different design factors which affect the system of performance calculations.

The book omits all consideration of the details of the design and construction of steam turbines, boilers, condensers, feed pumps, and other components necessary in the modern steam-power plant. In the first seven chapters, the book follows with admirable continuity its main theme of accurate steam-turbine-performance calculations. The first three chapters provide a background on steam-turbine characteristics, feed-heating arrangements and conclude with worked-out examples of flow distributions and heat balances for typical nonreheat and reheat cycles.

Chapter 4 introduces the intricate calculations predicting large turbine-generator performance by means of worked-out examples. Curves are provided giving corrections for partial-load operation, mean-of-valve loops, governing-stage pitch-diameter, exhaust pressure, moisture, rpm of condensing section, exhaust loss, generator loss, mechanical losses, shaft-packing leakage, valve-stem leakage, moisture-removal devices. From these calculations, turbine-expansion lines are drawn on the Mollier Chart of Keenan and Keyes. For performance calculations, these expansion lines are assumed to be the loci of extraction steam points.

Chapters 5, 6, and 7 consider the differences in performance of turbine-plant cycles due to different steam conditions, single and double reheat, optimum final feedwater temperature, number of feedwater heaters, external feedwater heating, turbine-driven boiler feed pumps, and so on. Chapter 7 concludes with worked-out examples of gross heat rates suitable for the comparison of alternate turbine-plant cycles.

Chapter 8, by R. C. Sheldon, considers the performance of gas-turbine cycles and, in particular, discusses the probable performance of combined gas-turbine-steam-turbine cycles using either conventional or supercharged boilers. The effect of various cycle parameters on the performance of these combined cycles is worked out and presented in the form of graphs.

At this point, the theme of the book changes from performance to economics. Electric-utility companies in the United States operate within a framework of public regulation, the Federal Power Commission, and the Public Utility Commissions of the various states. In chapter 9, the author develops special economic relationships appropriate for this regulatory structure which facilitate the economic evaluation of alternative power-plant designs. The method is demonstrated with several worked-out examples. The concluding three chapters provide general background information and representative data on the costs of constructing and operating steam-power stations.

Considering the book as a whole, it is clearly oriented toward the needs of the power industry, and only the more-gifted professors will be able to use it as an engineering college textbook. The general tone and pattern of words and notations are not those of the classroom, but rather those associated with a long visit to Schenectady. In its quiet, meticulous way, this book is also a challenge to other manufacturers of steam-power plant components to publish equally frank and authoritative methods and the specific data necessary to predict the performance and economics of their products.

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[1] Professor of Mechanical Engineering, University of Missouri, Columbia, Mo. Mem. ASME.

The most important contributions of this book, in this reviewer's opinion, are those presented in chapter 4. Here the author gives a method and the necessary specific data to predict the performance of a large steam turbine-generator. This material has been verified by its active use for some years by the Large Steam Turbine-Generator Department of the General Electric Company. Because of the prestige and authority of this source, this book will be of great interest to all engineers interested in the design and performance of large steam-power stations.

BOOKS RECEIVED IN LIBRARY

Modern Air Conditioning, Heating, and Ventilating
By W. H. Carrier and others. Third edition. 1959, Pitman Publishing Corporation, New York, N. Y. 592 p., $7\frac{1}{2} \times 10\frac{1}{2}$ in., bound. $12. This edition presents a thorough revision of all chapters where significant advances have been made in the past decade. Additions to the volume include a section on psychrometric processes, new material on factors influencing comfort, and an expanded treatment of basic cycle theory. Also added are a section on high-velocity air duct design and a chapter on industrial systems. Volumetric efficiency, work, and horsepower receive a more theoretical treatment, while the chapter on the heat pump has been expanded and given a more rigorous theoretical treatment. The appendix includes many new tables such as solar azimuth angles and intensity data, summer degree-days for cooling, and properties of refrigerants 113 and 500.

Patents for Engineers
By L. H. A. Carr and J. C. Wood. 1959, Chapman and Hall, London, England. 107 p., $5\frac{1}{2} \times 8\frac{3}{4}$ in., bound. 18s. British patent law is dealt with briefly and in simple terms with emphasis on engineering and commercial aspects. Among those topics considered are an outline of the British patent system; legal aspects, including rights, actions, and kindred rights such as trade-marks; patent specifications; historic patents; and miscellaneous provisions dealing with the validity of a patent, infringement, employees invention, etc. Technical legal phraseology has been avoided where possible.

Petroleum Processing
By R. J. Hengstebeck. 1959, McGraw-Hill Book Company, Inc., New York, N. Y. 348 p., $6 \times 9\frac{1}{4}$ in., bound. $10. A practical guide to various petroleum-refining processes from the standpoint of the practicing petroleum technologist. It describes all major refining processes concisely, points up their important aspects, discusses each process in broad terms, and provides references to sources of more detailed information. Information is included on such topics as products and raw materials; separation processes; moving beds and fluidized beds of solids; pyrolysis; catalytic cracking and reforming; alkylation and polymerization; isomerization; lube oil, wax, and asphalt processes; hydrogenation; acid, clay, and hydrogen treating; and sweetening and mercaptan extraction.

Progress in Nuclear Energy
(Series X, Law and Administration v. 1 and 2.) Edited by Herbert S. Marks. 1959, Pergamon Press, New York, N. Y. 994 p., $6\frac{1}{2} \times 9\frac{1}{4}$ in., bound. $26.50. The legal and administrative aspects of nuclear energy are presented in two volumes in one. The first deals with the broad features of the law and its administration in the United States and the United Kingdom, and with Euratom and other important international agencies and arrangements. The second is a compilation of the laws and decrees that twenty-five representative countries have adopted. Brief introductory commentaries preface and help to explain the laws and decrees published. Also included in this volume are the treaties, international agreements, and related documents establishing the international agencies and arrangements described in the first volume.

Progress in Nuclear Energy
(Series III, Process Chemistry, v. 2.) Edited by F. R. Bruce and others. 1958, Pergamon Press, New York, N. Y. 579 p., $6\frac{1}{2} \times 9\frac{1}{4}$ in., bound. $17.50. Reports on progress in chemical processing that has occurred since the first volume of the series appeared in 1955. The scope of the subjects covered has been considered, so that new chapters have been included not only on the preparation of those chemical intermediates which occur between crude concentrates obtained from ores and feed materials for reactors, but also on recovery processes associated with the treatment of ores and the treatment of irradiated fuels. Some of the new ideas which are potentially valuable for fuel processing are indicated, while at the same time papers are included which summarize experience and progress in orthodox solvent extraction processes.

Quality Control and Industrial Statistics
By A. J. Duncan. Revised Edition. 1959, Richard D. Irwin, Inc., Homewood, Ill. 946 p., $6\frac{1}{4} \times 9\frac{1}{4}$ in., bound. $10.80. The basic principles and procedures of statistical quality control are presented. Beginning with a section on the fundamentals which covers probability, frequency distributions, and sampling, the author continues with sampling inspection and control charts. The concluding part discusses statistical theory pertinent to industrial research and includes the estimation of lot and process characteristics, the theory of comparisons, analysis of components of variance, regression, analysis of covariance, and design of experiments. In this edition practically all of the material has been revised and expanded.

Quenching of Steels
Published 1959(?) by The American Society for Metals, Cleveland, Ohio. 77 p., $8\frac{1}{2} \times 11$ in., paper. $2.95. Papers included discuss the fundamental processes of quenching, quenching as a thermal process, evaluation of a quenching media, hot oil quenching, basis of selection of quenching media, and the automatic quenching of steel. The papers were presented at the 40th National Metal Congress, Cleveland, 1958.

Random Vibration
(Notes for the M.I.T. Special Summer Program, 1958.) By S. H. Crandall. 1959, Technology Press, Cambridge, Mass. Various pagings, $6 \times 8\frac{3}{4}$ in., paper. $10. The recent development of high-power rocket and jet engines has introduced new aspects to the problem of mechanical vibration, since these units generate noise and vibrational energy in a stochastic manner over a wide band of frequencies. The twelve papers included are concerned with this problem and assume that the reader is already familiar with the classical problem of mechanical vibration. The first part of the book deals with the new concepts required to extend ordinary vibration theory into the field of random vibration while the last part gives a broad picture of the current state of the art of designing and testing equipment which must withstand random vibration.

Le Turboréacteur et Autres Moteurs a Réaction
By A. Kalnin and others. 1958, Dunod, Paris, France. 401 p., $6\frac{1}{2} \times 9\frac{1}{2}$ in., paper. 5300 fr. A textbook on jet aircraft with emphasis on turbojets which begins with a survey of the general principles of jet propulsion and the fuels used. A detailed description of the turbojet follows covering compressors, combustion chambers, exhaust tubes, firing systems, thrust, and acceleration to supersonic speeds. Installation and maintenance of turbojets are discussed and the book concludes with brief descriptions of other types of jet motors including turbojets, ramjets, pulsejets and turboprops.

Wage and Salary Administration
By L. C. Lovejoy. 1959, The Ronald Press Company, New York, N. Y. 502 p., $6 \times 9\frac{1}{4}$ in., bound. $7. A study of the methods and problems of determining appropriate and equitable rates of compensation. Policy-setting, job establishment, and direct and indirect payment plans are covered as are employer assignment, performance appraisal, rate adjustment, co-ordination of wage scales, and research. Emphasis is placed on the fundamentals underlying sound modern practice rather than on the more transient procedures and techniques. Contrary to current practice, job evaluation is considered to be an integral part of compensation administration.

Welding of Plastics
By J. Neumann and F. J. Bockhoff. 1959, Reinhold Publishing Company, New York, N. Y.

279 p., $6^1/_4 \times 9^1/_4$ in., bound. $7.25. The physical and chemical properties of individual plastics presently used for welded construction are discussed in relation to their use in chemical and allied processing. The various techniques of welding used are also discussed, and detailed procedures are given accompanied by suitable illustrations. Features of the volume include complete corrosion resistance tables and a concise guide to the choice of an appropriate plastic construction material. Two complete chapters are devoted to design considerations as they affect welded construction, and to testing and evaluation.

Zehnteilige Einflusslinien für Durchlaufende Träger, Band 1

By Georg Anger. 1958, Wilhelm Ernst and Sohn, Berlin, Germany. 271 p., $7 \times 9^3/_4$ in., bound. 41 DM. Vol. 1 of this useful reference work, "Ten-Division Influence Lines for Continuous Beams," gives a detailed treatment of the derivation and use of equations for the rapid and accurate calculation of continuous beams in cases of arbitrary number of spans, span lengths, and loads, and for various bearing conditions at the end supports. Extensive graphical and tabular data are included to facilitate its practical use.

ASTE Collected Papers, 1959, Book 1

Published 1959 by American Society of Tool Engineers, Detroit, Mich. Various pagings, $8^1/_2 \times 10^3/_4$ in., paper. No price given. Papers on such aspects relating to tool engineering as product engineering, fabricating processes, manufacturing planning and control, tooling design, metalworking principles, quality control, manufacturing management, and miscellaneous topics.

ASTM Standards on Textile Materials

Published 1958 by the American Society for Testing Materials, Philadelphia, Pa. 880 p., 6×9 in., paper. $7.50. Of the 128 standards included in the present volume, 30 are recently revised and eight are new. They provide methods of tests, tolerances within which textiles must come in order that they may constitute good delivery on contract, and specification requirements. Among the new standards given are methods of test on extractable matter in oven dried wool, fiber length of wool, and moisture in wool by oven drying.

Advances in Inspection Techniques as Aids to Process Control in Non-ferrous Metals Production

Published 1958 as Monograph and Report Series No. 24 by The Institute of Metals, London, England. 103 p., $8^3/_4 \times 11^1/_4$ in., bound. $4.65. Papers discussing automatic gage control in rolling mills; measurement, inspection, and automatic process control in the steel-strip finishing and tinplate industry; ultrasonic testing for the control of quality in the manufacture of aluminum alloys and other nonferrous materials; instrumentation in ultrasonic flow detection; inspection of tubes for flaws and variations in thickness; advances in radiographic techniques; accuracy of strip-thickness measurement by beta and gamma absorption.

Advances in Petroleum Chemistry and Refining, Vol. 2

Edited by K. A. Kobe and J. J. McKetta, Jr. 1959, Interscience Publishers, Inc., New York, N. Y. 634 p., $6 \times 9^1/_4$ in., bound. $14.50. Critical evaluations of recent developments in petroleum refining and in petrochemicals. Topics dealt with include raw materials, trends in lubricants, pebble heaters, radiation techniques, sulfuric acid, alkylation of paraffins, coking petroleum residues, radiation processing, synthetic detergents from chemicals, commercial production of hydrazine and mechanical aspects of Houdriflow catalytic cracking.

Advanced Structural Analysis

By S. F. Borg and J. J. Gennaro. 1959, D. Van Nostrand Company, Inc., Princeton, N. J. 368 p., $6^1/_4 \times 9^1/_2$ in., bound. $7.50. A comprehensive analysis of structural theory and its applications. A discussion of the various methods for determining deflections and for solving statically indeterminate structures is first presented, and then followed by advanced topics of current interest such as the theory of arches with reference to the deflection theory, numerical and approximate methods of analysis, torsion analysis, limit design, and temperature analysis. Special chapters deal with the basic theory and design methods of shell structures and with the use of electronic computers to solve structural problems. Throughout the book, an attempt is made to present the basic theory as completely as possible, and then to show the actual engineering applications of the theory.

Air Conditioning Refrigerating Data Book Refrigeration Applications, Vol. I, No 1

Published 1959 by The American Society of Refrigerating Engineers, New York, N. Y. Various pagings, $8^1/_4 \times 11^1/_4$ in., bound. $12. This volume is the first of a four-volume series intended to be published over a four-year period. Each chapter has been thoroughly reviewed, and rewritten and reorganized. Topics covered include refrigerated food and beverage processes, frozen-food processing, refrigerated warehouse practice, refrigerated and frozen-food distribution, low-temperature applications, industrial applications of refrigeration, and pipe-system applications. Extensive bibliographies are included throughout.

Applied Petroleum Reservoir Engineering

By B. C. Craft and M. F. Hawkins, Jr. 1959, Prentice-Hall, New York, N. Y. 437 p., $6^1/_4 \times 9^1/_4$ in., bound. $12. Primarily concerned with the application of reservoir-engineering data to the calculation of reservoir contents and recovery potentials and to the analysis and prediction of reservoir performance under a variety of production methods. Topics covered are gas reservoirs; gas-condensate reservoirs; undersaturated oil reservoirs; oil reservoirs under simultaneous dissolved gas drive, gas-cap drive, and water drive; water influx; fluid flow in reservoirs; and the displacement of gas. Theoretical mathematical forms are derived and illustrated by numerical examples and field studies to describe the types of well and reservoir behavior encountered in modern practice.

Approximate Methods of Higher Analysis

By L. V. Kantorovich and V. I. Krylov. 1958, Interscience Publishers, Inc., New York, N. Y. 681 p., $6^1/_2 \times 9^1/_4$ in., bound. $17. In many of the practical problems of technology, mathematical solutions either cannot be found or entail such a complicated structure as to be extremely difficult. The approximate methods described permit the determination of an approximate solution for a wide variety of cases, and in application require simple and realizable computations. The authors discuss methods based on the representation of the solution as an infinite series, the approximate solution of the integral equations of Fredholm, the method of nets, variational methods, the application of conformal transformation to the solution of the fundamental problems for canonical regions, and Schwarz's method. The text is translated from the Russian.

Berechnen und Entwerfen der Schweisskonstruktionen

(Praktisches Handbuch der Gesamten Scheweisstechnik, Vol. 3)

By J. Ruge. Second Edition. 1959, Springer-Verlag, Berlin, Germany. 334 p., $6^1/_2 \times 9^1/_2$ in., bound. 33.60 DM. This manual on the calculation and design of welded structures covers a wide range, with examples for the construction of machines in general, electrical machines, pipelines, bridges, ships, cranes, vehicles, boilers, and general steel work. There are also sections dealing with the physical properties and weldability of structural steels and with strength ratings of joints under static and dynamic stresses. The book is profusely illustrated and presents the technical data in tabular or graphic form for ready use.

Beton Precontraint. Tome 2: Constructions Hyperstatiques

By Y. Guyon. 1958, Eyrolles, Paris, France. 818 p., $7^1/_4 \times 10$ in., bound. 9300 Fr. The second volume of a theoretical and practical treatise on prestressed concrete, this book treats of statically indeterminate structures such as beams, girder frames, concrete slabs, and arches. Their construction, elasticity, resistance to stress, and the relationship of the statically indeterminate structure to loss of tension are dealt with. The book concludes by deriving formulas for calculating the cracking and failure points of these structures under various kinds of stress.

Bibliography of Monolingual Scientific and Technical Glossaries

Published 1959 by UNESCO. Distributed by Columbia University Press, New York, N. Y. 146 p., $6^1/_8 \times 9^1/_2$ in., paper. $2.50. The first volume of this series contained references to standard glossaries and to publications about them. The present volume, which is the second, contains glossaries published privately. It refers to 1043 publications of this type representing 26 languages. The glossaries listed are arranged according to subject by means of the Universal Decimal Classification system.

The Building of the TVA

By J. H. Kyle. 1958, Louisiana State University Press, Baton Rouge, La. 162 p., $7^1/_3 \times 10^1/_3$ in., bound. $7.50. An illustrated history of the TVA written in honor of its 25th anniversary. The 20 dams and eight steam plants extending over five states and 41,000 sq miles in the Tennessee River Basin are described and profusely illustrated with diagrams and photographs.

Dictionary of Guided Missiles and Space Flight

(Principles of Guided Missile Design, Vol. 5)

Edited by Grayson Merrill. 1959, D. Van Nostrand Company, Inc., Princeton, N. J. 688 p., $7^1/_2 \times 10^1/_4$ in., bound. $17.50. A reference work for persons concerned with research, design, or operation of guided missiles and spacecraft. The terms defined and explained comprise the names of guided missiles and spacecraft; the various guidance and control, propulsion armament, and launching systems of which they are formed; the components that make up those systems; and related terms from aerodynamics, astrodynamics, electronics, astronomy, and physics. Also given are terms for types of antennas, circuits, radar systems, and propellants as well as important laws, relationships, equations, space environments, and concepts which govern design.

Dimensional Control in Precision Manufacturing

By J. L. Gadzala. 1959, McGraw-Hill Book Company, Inc., New York, N. Y. 203 p., $5^3/_8 \times 8^3/_4$ in., bound. $7.50. Covers the fundamentals and methods of dimensional control to effect higher production and lower unit costs in production machining. The author explains in detail the "method of traces" used to calculate accumulations of dimensional tolerances in a sequence of machining operations so as to construct a reliable tolerance chart. To illustrate this method the necessary steps for developing a complete set of operation sheets for an exemplary production part are given. Dimensions and tolerances in special applications are treated, as well as the charting of dimensional tolerances on symmetrical parts such as housings.

Electric Cranes
By H. H. Broughton. Third Edition. 1958, E. & F. N. Spon, Ltd., London, England. 511 p., $7^1/_2 \times 10$ in., bound. £710s. The present edition has been completely rewritten and newly illustrated. In general it contains information considered to be useful to those interested in mechanical handling with particular reference to the design, construction, and application of electric cranes. Details are also given of recent authoritative structural, mechanical, and electrical research affecting the design and operation of cranes. Concluding chapters describe overhead traveling cranes, jib cranes, bulk unloaders and grabbing cranes, and fitting-out cranes. Numerous illustrations and tables as well as lists of references add to the value of the book.

An Evaluation of the Present Understanding of Metal Cutting
By Battelle Memorial Institute. 1959, American Society of Tool Engineers, Detroit, Mich. 275 p., $8^1/_2 \times 11$ in., paper. $7.50. The final report of a survey and evaluation of metal-cutting literature made as part of an over-all program directed toward establishing basic principles in the field of metal cutting. This report is composed of nine sections each of which is an interpretive summary on a specialized topic: General knowledge of metal cutting; mechanism of chip formation; effect of normal stresses on shear flow strength; some thermal and physical aspects of cutting; wear and life of single-point carbide tools; cutting fluids; influence of metallurgical properties on metal-cutting operations; reporting methods; recommendations for further research.

Fabrication of Molybdenum
Published 1959 by the American Society for Metals, Cleveland, Ohio. 221 p., $8^1/_2 \times 11$ in., paper. $6.50. Presents the state of the art of the fabrication of molybdenum components with a view to establishing a common technological foundation upon which future fabrication efforts might be based. The papers included review the details of the techniques used to form, weld, protect, and otherwise fabricate molybdenum parts, and represent the technology developed and practiced by the leading metallurgists concerned with the application of refractory metals to their products.

First Steps in Heat Transfer
By James Small. 1959, Blackie and Son, Ltd., Glasgow, Scotland. 86 p., $5^3/_4 \times 9$ in., bound. 12s. 6d. A brief introduction to the principles and practice of heat transfer which requires only a moderate amount of mathematics. An exploration of nondimensional parameters and their usefulness in the treatment of convective heat flow is given, but no attempt is made to deal with the theory of similarity as a mathematical exercise in itself. Solutions to examples are given.

Handbuch der Staubtechnik
Vol. 2 Staubtechnologie
By Robert Meldau. Second Edition. 1958, VDI-Verlag GmbH, Düsseldorf, Germany. 435 p., $7^1/_4 \times 9^3/_4$ in., bound. 61 DM. Beginning with sections on dust particles and dust deposits, this second volume of a handbook on dust technology continues with the practical aspects of the machines and processes for dust removal. It describes in detail cyclones, filters, electrostatic and magnetic precipitators, etc., and gives examples of installations in a variety of industries: Mining, metallurgical cement, textile, and general manufacturing. There is a chapter on the fluidization process, and an extensive classified bibliography is appended.

LIBRARY SERVICES

Engineering Societies Library books, except bibliographies, handbooks, and other reference publications, may be borrowed by mail by ASME members for a small handling charge. The Library also prepares bibliographies, maintains search and translation services, and can supply a photoprint or a microfilm copy of any item in its collection. Address inquiries to R. H. Phelps, Director, Engineering Societies Library, 29 West 39th Street, New York 18, N. Y.

IES Lighting Handbook
Published 1959 by the Illuminating Engineering Society, New York, N. Y. Third Edition. Various pagings, $6^1/_4 \times 9^1/_4$ in., bound. $10. Detailed revision of a practical handbook. The first half is concerned with general concepts and covers the physics of light, light and vision, standards and nomenclature, measurement of light and other radiant energy, color, light control, light sources, and lighting calculations. The second half deals with specific applications including offices and schools, institutions and public buildings, industries, residential lighting, outdoor lighting, sports lighting, roadway lighting, and transportation lighting.

Kinematisch-Getriebeanalytisches Praktikum
By Rudolph Beyer. 1958, Springer-Verlag, Berlin, Germany. 172 p., $6^3/_4 \times 9^3/_4$ in., bound. DM. 28.50. The purpose of this book is to explain the application of kinematic theory to more complicated practical problems. Following a survey of fundamentals and a description of some geometrical methods not found in other textbooks, the author deals with multihinge linkages, gear crank trains, cams, band drives, and screw mechanisms, with particular attention to machine tool and other production machinery mechanisms. Kinetostatic as well as dynamic applications are covered; modern mathematical methods of complex number analysis and matrix calculus are briefly considered; and practical numerical examples are given.

Law for Engineers and Architects
By Lawrence P. Simpson. Fourth Edition. 1958, West Publishing Company, St. Paul, Minn. 506 p., $7^3/_4 \times 10^1/_4$ in., bound. $7.50. Discusses those branches of the law which bear most directly upon the engineering profession, and illustrates by means of cases how the courts have applied the rules stated in the text to concrete situations involving engineers, architects, builders, and owners. The first half of the book is devoted to contracts, while the second half is concerned with the law of agency, mechanics' liens, workmen's compensation, and property. Standard forms of construction contracts, invitations to bidders, subcontracts, contracts between architect and owner, etc. are given in the appendix.

Linear Structural Analysis
By P. B. Morice. 1959, The Ronald Press Company, New York, N. Y. 170 p., $6^1/_4 \times 9^1/_4$ in., bound. $6. A study of the equilibrium analysis of linear elastic structures. In this method the changes in geometry of the structures under load are sufficiently small to have a negligible effect upon loads and their corresponding stress distributions, and the structural materials obey Hooke's law. This method of structural analysis is described in conjunction with linear matrix algebra techniques. Topics discussed include influence coefficients; indeterminacy; properties of matrices; computation; scale factors; stress resultant distributions, lack of fit and settlement; transformations; release system relations; flexibility matrix; and machine analysis.

Liquid Helium
By K. R. Atkins. 1959, Cambridge University Press, New York, N. Y. 312 p., $5^3/_4 \times 8^3/_4$ in., bound. $11. The study of liquid helium is of considerable importance because of the light it sheds on the nature of fluids. This monograph provides a review of the current state of the theory concerning liquid helium as well as a detailed survey of experimental results. Topics covered include equilibrium properties, thermohydrodynamics, first and second sound, helium [illegible] helium three, and various helium mixtures. [illegible] extensive bibliography is included.

The Manufacture of Iron and Steel.
Vol. Two: Steel Production
By G. R. Bashforth. Second Edition. 1959, Chapman and Hall, Ltd., London, England. 390 p., $5^3/_4 \times 8^3/_4$ in., bound. 40s. This revised edition contains a considerable amount of new material particularly in the description of new methods and processes of steel manufacture. Those aspects discussed include blister, shear, and crucible steel; Bessemer process; side blown converter process; open-hearth process; electric furnaces; ingots and ingot production; special types of steels; miscellaneous steelmaking processes.

Mathematics Dictionary
Edited by Glenn James and R. C. James. Multilingual Edition. 1959, D. Van Nostrand Company, Inc., Princeton, N. J. 546 p., $6^1/_4 \times 9^1/_4$ in., bound. $15. Substantially revised and enlarged, this edition contains more than 7000 mathematical terms, concepts, and relationships ranging from elementary terms in arithmetic through calculus. In addition, multilingual indexes giving their Russian, German, French, and Spanish equivalents are provided. New basic terms have been added in the fields of modern algebra, number theory, topology, vector spaces, the theory of games, linear and dynamic programming, numerical analysis, and computing machines. Useful tables and mathematical symbols are given.

Metal Cutting Tool Handbook
Published 1959 by The Metal Cutting Tool Institute, New York, N. Y. 750 p., $6 \times 9^1/_4$ in., bound. $7.50. This revised edition presents the latest data on twist drills, reamers, counterbores, taps, dies, milling cutters, hobs, gear shaper cutters, gear shaving cutters, and broaches. Each section contains information on the design, proper application, and the maintenance procedures of the tools described and is followed by tables of dimensions and tolerances of standard sizes of tools. New developments in tool materials, tool design, and materials to be cut are included throughout. Engineering tables and other data commonly used in the metal-cutting industries are given in a special section.

Current Engineering: Events, News, and Comment

E. S. NEWMAN
News Editor

THE ROUNDUP

Left, Jerry Fijimoto, engieering student, **center,** Herbert Hoover, **right,** Andrew Fletcher, UET President.

United Engineering Center:

Ground Is Broken; Construction Begins

Former President Hoover Addresses Gathering

"This is an event of national importance.

"The Engineering Societies in our country compose a membership of 300,000 men and women covering almost every branch of the profession. They are the foundation of security in our defense and the increase of our standard of living and comfort."

So said Former President Herbert Hoover, Hon. Mem. ASME, at the ground-breaking ceremonies on Oct. 1, 1959, for the United Engineering Center. The new Center will be constructed opposite the United Nations in New York City.

Herbert Hoover, Former U. S. President, Hon. Mem. ASME, Says:

"The Engineering Societies are the foundation of security in our defense and the increase of our standard of living and comfort."

"The Engineering Societies are in reality a great educational institution," Mr. Hoover continued. "Within the Societies is the constant exchange of discovery, improvements, and experience. Their findings are printed for all the world to see."

In the actual ground-breaking ceremonies, Mr. Hoover, representing the older generation of engineers, shared earth-turning honors with a freshman engineering student from Hawaii, Jerry Fujimoto, representing engineers of the future. Mr. Fujimoto, an American citizen of Japanese extraction, enrolled this fall at Rensselaer Polytechnic Institute, Troy, N. Y. He is described as a member of the newest engineering class, entering the oldest engineering college in the country from the newest state in the Union.

The United Engineering Center will occupy the block between 47th and 48th Streets, on United Nations Plaza (First Avenue). It will be 18 stories high with 263,000 sq ft of floor space. The building, a slim tower of glass, metal, and limestone rising from a broad 2-story base, is scheduled for completion in 1961. Estimated cost: $12,000,000.

Willis F. Thompson, Fellow ASME, who participated in the ceremonies, said that "it is planned that the center will be occupied by some 600 members of the staffs of 18 societies and joint bodies serving a membership of approximately 250,000 and about 50,000 additional engineering students. It will offer modern useful space for meetings of members and committees of these bodies."

Mr. Thompson is vice-president, United Engineering Trustees, chairman of UET Real Estate Committee, and vice-president of Westcott and Mapes, Inc., Engineers, New Haven, Conn.

"Its [Engineering Societies] Library will, in new expanded quarters, continue to be the nation's, and probably the world's most complete repository of engineering knowledge," he said. "Indexing and abstracting services sponsored by these groups will continue to provide a means whereby engineers anywhere may locate and use available information in dozens of engineering fields.

"The design of the Center will provide for expansion to accommodate the continuing growth of the occupying bodies, and the even greater service essential for future generations. Within the means at our disposal, the new Center will incorporate every advanced feature and facility that the architectural and en-

(*Continued on page 118*)

A MESSAGE FROM THE PRESIDENT

I HAVE just returned from a swing to the Pacific Coast and down into Texas, and I think I have been able to sense the origin of some of the opposition and reluctance to contribute to the United Engineering Center in regions remote from New York. It stems, I believe, from a misunderstanding, which may be quite widespread, as to what this Center is intended to be. In order to correct this misunderstanding, I would like to say first what it is not to be, and then what it is to be.

It is not to be a gathering place where engineers congregate socially or for other similar purposes. It is not in any respect to be like the very excellent engineering buildings serving local groups of engineering societies for such purposes in the cities of Cincinnati, Cleveland, Detroit, Houston, Denver, Fort Worth, San Francisco, and others which I have visited. These buildings take on the character of an engineers' club, serve as the focus for numerous social and professional meetings in the area, and it is only to be regretted that they are not established more widely. The United Engineering Center located in New York is not to serve in this capacity for engineers located in or near New York.

In contradistinction, this building will serve as the headquarters business office for the staffs of the five Founder Societies, plus ten associated societies and six other organizations. It will replace the present Engineering Societies Building erected in 1906 as a result of a gift from Andrew Carnegie. The United Engineering Center will provide office space for about 600 people.

In addition, it will be the means of improved services to the members of the Societies it houses and the engineering profession.

First, it will house the Engineering Societies Library, the largest technical library in the world. As such, it will serve on demand, with new and modern equipment, the library search needs for nearly 250,000 members.

Second, it will have numerous small meeting rooms for carrying on the business of the literally hundreds of working committees of the several societies. These are the committees doing the program-making, standardization, codification, and research work of the various societies as well as the administrative functions and Council and Board activities.

Third, it will accommodate the editorial staffs concerned with the publication of the periodicals, transactions, individual papers, books, Codes and Standards, etc., and which are the principal permanent technical contributions of the societies to engineering progress and literature.

Fourth, it will permit the mechanization with modern equipment (on a common basis to the extent possible) of the clerical, accounting, and other similar work of the several societies which now serves a membership fifteen times greater than that which they served when the present building was built. This should considerably improve service to the individual members.

There will be a small foyer or exhibit room on the first floor which will serve to impress the numerous visitors in that area (the building is adjacent to the United Nations) with the contributions and importance of the engineering societies and the engineering profession. The Center is not designed to handle the major meetings of the societies. They will still be conducted, as at present, in convention type hotels in cities distributed throughout the country.

Further, we all want increasing recognition of the Engineering Profession. Recently, there has been much concern that the scientists are getting the recognition that to a very great degree belongs to the engineer and this, I believe, is true. There are many of us who believe that this great building in a conspicuous location in New York City, opposite the United Nations, may well serve as a world-wide symbol of the importance of the Engineering Profession.

What I am trying to say is that this United Engineering Center, carefully located in New York for numerous sound reasons as a result of a study by a top-level committee with representation of the Founder Societies from many parts of the Country, is established to modernize and bring up to date the headquarters of the principal engineering societies in this country, and is so organized and planned as to serve the best interests of all of the members of these societies irrespective of where they are located.

Glenn B. Warren, President
The American Society of Mechanical Engineers

AAAS to Hold 126th Annual Meeting in Chicago, Ill., December 26–31, 1959

Morrison Hotel, Headquarters; La Salle Hotel, Section M—Engineering Meeting, December 28-29

THE 126th Annual Meeting of the American Association for the Advancement of Science will be held December 28-29, 1959. The program planned by Section M—Engineering will take up national and international aspects of systems of units. The meeting designated as Operation Scuds: Simplification, Clarification, Unification, Decimalization, and Standardization.

Section M—Engineering Program

▶MONDAY, DECEMBER 28

Part I—The Confusion of Chaos in Units **Morning**

Presiding: *Carl F. Kayan*

International Viewpoint of an American Engineer on Units, by *Walker L. Cisler*, ASME President-Elect, New York, N. Y.

Should American Industry Convert to the Metric System? Summary of Views Recently Expressed by Industry, by *G. P. Hussey, Jr.*, Managing Director, American Standards Association, New York, N. Y.

Our Units of Weights and Measures, by *Lewis V. Judson*, Office of Weights and Measures, National Bureau of Standards, Washington, D. C.

International Challenge to American Education and Its Relationship to the Unit System, by *John J. Theobald*, Superintendent of Schools, New York, N. Y.

Farmers' and Grain Processes—Unit Simplification, by *Hamill Varner*, Manager, Grain Purchasing Department, Quaker Oats Co., Chicago, Ill.

The Chaos in Consumer Goods Packaging, by *Colston E. Warne*, President, Consumers Union, Mount Vernon, N. Y.

Part 2—Public Education vs. the Consumer Public **Afternoon**

Presiding: *H. C. Diehl*

Decimalization in the Schools, by *James H. Smith*, Associate Superintendent of Instruction, Board of Education, Chicago, Ill.

Children vs. Decimals and Other Fractions, by *Lore Rasmussen* and *David A. Page*, Univ. of Illinois Arithmetic Project, Urbana, Ill.

Food Container Standardization and the Public Interest, by *Howard Stier*, National Canners Association, Washington, D. C.

Packaging Identification and Marking, by *Allyn C. Beardsell*, Director of New Products Division, The Mead Corp., Cincinnati, Ohio

Common Fractions vs. Decimals in Stock Exchange Reporting, by *Robert M. Bishop*, Special Assistant to the President, New York Stock Exchange, New York, N. Y.

▶TUESDAY, DECEMBER 29

Part 3—Problems of Design, Manufacture, and Commerce **Morning**

Presiding: *Robert J. Painter*

An Investigation of the Effect of Foot Decimalization on Building Design and Construction Processes, by *Perry Coke Smith*, Architect, Voorhees, Walker, Smith, Smith and Haines, New York, N. Y.

Measuring Units for the Textile Industry—Present and Prospective, *by Arthur D. Scroggie*, Textile Fibers Department, E. I. du Pont de Nemours & Co., Wilmington, Del.

English and Metric Systems of Measurements in the Forest-Products Industries and Their Effect on Manufacturing and Construction Practices, by *A. J. Panshin*, Head Department of Forest Products, Michigan State Univ., East Lansing, Mich.

Machine Tools and the Inch—Meter Conversion, by *H. S. Sizer*, Director of Design, Machine Tool Division, Brown and Sharp Mfg. Co., Providence, R. I.

Weighing With Decimals, by *R. E. Bell*, Chief Engineer, Toledo Scale Div., Toledo Scale Corp., Toledo, Ohio.

Pro's and Con's of the Weighing Problem vs. Decimal and Metric Changeover, by *C. G. Gehringer*, Manager, M-Scale Div., Fairbanks, Morse and Co., Chicago, Ill.

Part 4—The Look to the Future **Afternoon**

Presiding: *Clarence E. Davies*

The Decimal Idea in Handling Units, by *Chauncey D. Leake*, President-Elect, American Association for the Advancement of Science, Washington, D. C.

Progress Report on the Changeover Problems for Great Britain, by *A. H. Hughes*, Deputy Chairman, British Association Metric Committee, London, England.

Status of NBS Study-Project on Ways and Means to Accelerate Metric Changeover in the U. S. A., by *A. V. Astin*, Director, National Bureau of Standards, Washington, D. C.

Impact of the Multiplicity of Technical Disciplines on Unit-System Usages, by *Guy Waddington*, Office of Critical Tables, National Academy of Sciences—National Research Council, Washington, D. C.

Accelerated Progress in the Automotive Decimalization Program, by *Roy P. Trowbridge*, GM Engineering Standards, General Motors Co., Detroit, Mich.

Parke-Davis Adopts the Metric System, by *Don G. Neill*, Manager, Materials Handling Department, Parke-Davis Co., Detroit, Mich.

High Lights of the Special AAAS Report on Metric Usage, by *Wilmer Souder*, Chairman, AAAS Committee on Metric Usage, Washington, D. C.

Officers of Section M. Vice-President of AAAS and Chairman: Clarence E. Davies, United Engineering Trustees, Inc., New York, N. Y.; Secretary: E. Paul Lange, Engineers Joint Council, 29 West 39th Street, New York, N. Y.

Section M Program Committee. Carl F. Kayan, Department of Mechanical Engineering, Columbia University, New York, N. Y.; H. C. Diehl, Director, Trans-American Refrigerating Services, Colorado Springs, Colo.; Peter E. Glaser, Arthur D. Little Company, Cambridge, Mass.; M. J. Goglia, Dean, University of Notre Dame, South Bend, Ind.; Elmer L. Knoedler, Sheppard T. Powell Associates, Baltimore, Md.; and Harry C. Trelogan, Marketing Research Division, U. S. Department of Agriculture, Washington, D. C.

RESEARCH

Research Reactors

• McMASTER University, Hamilton, Ont., Canada, early this year began operation of the first privately owned nuclear research reactor in Canada. Supplied by AMF Atomics (Canada) Limited, a subsidiary of American Machine & Foundry Company, the reactor was financed jointly by research agencies of the Canadian government, the Hydro-electric Power Commission of Ontario, and by Canadian industry.

• NUCLEAR training and research reactors are also on schedule for the University of California at Los Angeles and the University of Washington, Seattle, Wash. AMF Atomics will supply the reactors which are of the "Educator" type. The Educator is a thermal heterogeneous reactor capable of operating continuously at 10 kw.

• A TRIGA research reactor has been placed in operation at the University of Lovanium, atop Mount Amba, 15 miles south of Leopoldville in the Belgian Congo. It is the first atomic reactor to be installed and operated in Africa. The TRIGA was conceived and produced by General Dynamics Corporation's General Atomic Division. The reactor has a steady-state operation power level of 10–30 kw and can be operated intermittently at power levels up to 100 kw.

Nuclear Boilers and Pressure Vessels

A BASIC research program aimed at improving the design and efficiency of boilers and other pressure vessels is under way at Southwest Research Institute. The work is jointly sponsored by the Atomic Energy Commission and the Pressure Vessel Research Committee of the Welding Research Council. The program will have three lines of approach:

(*a*) Static analysis of the stress distribution around openings;

(*b*) changes due to initial cycling; and

(*c*) the determination of plastic fatigue for a variety of nozzle configurations.

Sound-Wave Studies

CONSTRUCTION of an acoustical test chamber for the study of high-intensity sound waves has begun at Goodyear Aircraft Corporation's Arizona Division at Litchfield Park, near Phoenix, Ariz.

When completed, the facility will incorporate the latest devices for the investigation of sound waves and their effect upon the thousands of electronic components that are or will be used in the supersonic aircraft and missiles of today, and those of the foreseeable future.

Astronuclear Laboratory

An astronuclear laboratory where scientists will undertake the development of nuclear energy for outer space has been announced by the Westinghouse Electric Corporation.

The laboratory will be located in the Pittsburgh, Pa., district and will be part of a new Westinghouse Atomic Power Division that also will include existing activities of the company in the development of commercial applications of atomic energy for electric power generation. This division does not include the Bettis Atomic Power Laboratory of the U. S. Atomic Energy Commission which is operated by Westinghouse.

Information Searching Selector

The Center for Documentation and Communication Research, Western Reserve University, has announced completion of arrangements for the acquisition of the GE-250 Information Searching Selector. The high-speed machine is designed for scanning about 100,000 abstracts per hour in order to identify those abstracts that are pertinent to one or more of a number of simultaneously conducted searches. Delivery of the selector, which is being constructed by the Computer Department of the General Electric Company, is scheduled for early in 1960.

Cornell Hypersonic Tunnel

Cornell Aeronautical Laboratory's capabilities for testing in the hypersonic range—from speeds five to 20 times the speed of sound—have been extended greatly in recent months by the establishment of a new hypersonic tunnel department and a new hypersonic shock tunnel.

Wheel Studies

Research engineers at the University of Michigan's Automotive Laboratory are engaged in studies to produce scientific data applicable to "off the road" wheel behavior. They are seeking to learn the effects of wheel diameter, width, and surface shape on wheels designed for swampy, very soft, or very rocky, bumpy surfaces. They also are investigating the response of various soils to repeated pressure of many wheels on many vehicles.

Rigid Plastic Materials

A new contract for $28,325 from the Wright Air Development Center has been awarded to the Polytechnic Institute of Brooklyn for research on a critical problem of the space age, the cracking of rigid plastic materials under environmental stresses. Robert J. Ullman, associate professor of mathematics, who is a specialist in the mathematics of chemistry, is the director of the project.

With the increasing use of the lighter plastic materials as components of space vehicles and equipment, the unexpected cracking of these man-made, test-tube developed chemical materials cannot go unexplained. Since plastics began to replace natural materials, they have puzzled their users.

Dr. Ullman and his research assistants will study the curious type of breaking which occurs in certain environments. These studies will include work on nylon, radiation crosslinked polyethylene, and polystyrene. The research will consider how certain chemical environments interact with plastics and cause their strength to deteriorate. It is a problem which he had begun to study in general terms before the award of the Wright Center contract.

English-to-Braille on IBM

Translation of printed text into Braille at electronic speeds has been demonstrated with an International Business Machines Corporation electronic computer.

The procedure creates in minutes a raised Braille printing plate suitable for production of books for the nation's 350,000 sightless persons. It was developed by IBM mathematicians working in conjunction with the American Printing House for the Blind, leading Braille book publisher.

The new method of creating Braille was developed for a standard IBM 704 data-processing system. The 704 can translate a 300-page book in an hour—a job which would take more than six days for a skilled translator.

Texts to be translated by the computer are first transferred to punched cards by means of a key punch with a conventional typewriter keyboard. The cards are then fed directly into the computer, which has had previously stored in its memory a program or set of rules for conversion into Braille.

The machine executes as many as 600 instructions per word in less than the fortieth part of a second. The computer determines contractions and abbreviations by matching against an alphabetical table of braille equivalents.

The translated text emerges from the computer in coded symbols on punched cards, and these, in turn, are fed to a printer which reproduces the braille symbols above the English text for editing purposes. After editing, the corrected deck of punched cards is fed to an embossing machine which creates metal plates for use in a rotary press.

The program, which required a year for completion, was the work of the Mathematics and Applications Department of IBM's Data Processing Division headed by Dr. Joseph E. Flanagan.

Braille printing plate, produced electronically by an IBM 704 computer, is held by Dr. J. E. Flanagan, manager of IBM's Mathematics and Applications Department which developed the new technique. English text is transcribed at the rate of 4000 words per minute.

IBM ELECTRONIC DATA PROCESSING MACHINE

COMING MEETINGS

ASTE Seminars

A new series of scientific engineering seminars is being presented by the American Society of Tool Engineers. Programs are designed to explore new ideas and concepts of tool engineering. Subjects of the seminars will be: Metal Forming for Tomorrow's Manufacturing, What We Know Today About Metal Cutting, Some Problems of Machining Space Age Metals, Numerical Control in Creative Manufacturing, Optical Tooling Methods in Manufacturing, Automation and Your Production Program, Cost Reduction Through Plastic Tooling, and Metrology—A Review of Measurement Techniques. Seminars cover one, two, and three-day periods; and fees range from $30 to $75 for members of ASTE and its affiliates. For further information write: Education Director Gilbert E. Seeley, ASTE, 10700 Puritan Avenue, Detroit 38, Mich.

INDUSTRIAL FILMS

Graphite Studied on Film

"Dislocations in Graphite" records for the first time on film the dislocations or imperfections in the atomic arrangement of the structure of graphite. The 16-mm film runs 25 min and is available on request from the Public Relations Department, Atomics International, a division of North American Aviation, Inc., Canoga Park, Calif.

Assignment Outer Space

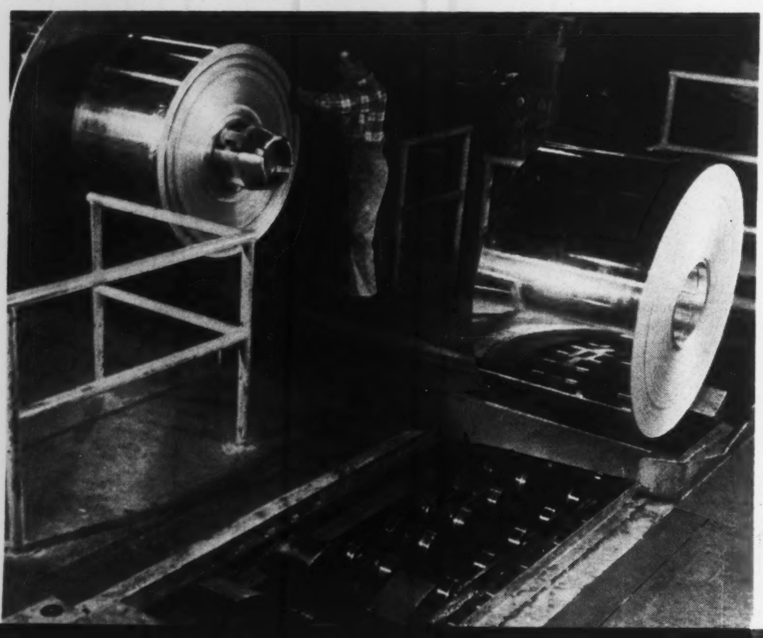
A 28-min motion picture describes work on re-entry vehicles for the Air Force Atlas and Thor as well as other missile and space projects. Designed for TV, school, and the general public, the 16-mm film is in color. Available from General Electric, Missile and Space Vehicle Department, Philadelphia 4, Pa.

LITERATURE

ASME Publications

The American Society of Mechanical Engineers issues annually a large number of publications. Many of these are the products of efforts of the Society's Boards and Committees working independently or in conjunction with other societies. A list of such publications obtainable from The American Society of Mechanical Engineers, 29 West 39th Street, New York 18, N. Y., follows:

"American Drafting Standards Manual: Section 10, Metal Stampings," ASA Y14.10-1959, $1.50, sponsored also by the American Society of Engineering Education under procedures of the American Standards Association.



"Handling Materials in the Steel Industry" shows the wide range of equipment used in steel making. This 25-min, 16-mm sound and color film pictures the equipment used in the handling of steel coils. Film shows gathering and crushing of ore, mining and preparation of coal for the production of strong, hard coke for blast furnaces and open hearths. Handling of steel coils through various processing operations to final shipment occupy an important part of film. Three different installations are shown and include hot-coil handling on down-tilters from the coilers, through cooling, into storage and reclaiming. Film is available without cost on letterhead request for showing in the U. S. Write to Public Relations Department, Link-Belt Company, Prudential Plaza, Chicago 1, Illinois.

"American Drafting Standards Manual: Section 17, Fluid Power Diagrams," ASA Y14.17-1959, $1.50, sponsored also by the American Society of Engineering Education under procedures of the American Standards Association.

"Gas Transmission and Distribution Piping Systems," ASA B31.8-1958, $2.50, under direction of Sectional Committee B31 of the American Standards Association.

"Reamers," ASA B5.14-1959, $2.50, sponsored also by the American Society of Tool Engineers, Metal Cutting Tool Institute, National Machine Tool Builders Association, and the Society of Automotive Engineers.

"Corrosion and Desposits in Boilers and Gas Turbines," $6, report of ASME Research Committee on Corrosion and Deposits from Combustion Gases by Battelle Memorial Institute.

"1958 Report on Oil and Gas Engine Costs" (Data for 1957 and Previous Years), $3, report of Subcommittee on Oil and Gas Engine Power Costs.

"Low-Pressure Heating Boilers," 1959, Section IV, ASME Boiler and Pressure Vessel Committees.

"Miniature Boilers," 1959, Section V, ASME Boiler and Pressure Vessel Code, $1.25, Boiler and Pressure Vessel Committees.

"Power Boilers," 1959, Section I, ASME Boiler and Pressure Vessel Code, $5, Subcommittee of Boiler and Pressure Vessel Committee on Power Boilers.

"Petroleum Refinery Piping," ASA B 31.3-1959, $4, prepared by Sectional Committee on Code for Pressure Piping B31.

Fatigue

"Symposium on the Basic Mechanisms of Fatigue," STP 237, is published by the American Society for Testing Materials. The 128-page, hard-covered symposium clarifies some basic mechanisms of fatigue failure such as dislocations, internal friction, crystalline, and structural changes, and surface disintegrations. Copies are available from ASTM Headquarters, 1916 Race Street, Philadelphia 3, Pa., at $3.75.

Radioisotope Contamination

"Maximum Permissible Amounts of Radioisotopes in the Human Body and Maximum Permissible Concentrations in Air and Water," NBS Handbook 69, is published by the National Bureau of Standards, U. S. Department of Commerce. The published handbook will be available from Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C.

Railroads

"Railroad Transportation and Public Policy," by James C. Nelson, was recently published by The Brookings Institution. The study examines reasons for the deteriorating economic position of the railroads since World War II, and points to the need for constructive action by government and by railroad management. The 544-page book cost $7.50.

Atomic Energy—Patents

"Selected Materials on Atomic Energy Patents" has been published by the Joint Committee on Atomic Energy. The volume contains background information on patent problems. The 289-page booklet is available from the U. S. Government Printing Office, Washington 25, D. C.

Standards

The 1959 Price List and Index of American Standards, just published, is available free from the American Standards Association, Department PR 66, 70 East 45th Street, New York 17, N. Y. The publication lists the more than 1800 American Standards approved to date by the American Standards Association.

Air Pollution

"Proceedings of the National Conference on Air Pollution" are available through the U. S. Department of Health, Education, and Welfare, Public Health Service. The volume constitutes a valuable reference work for persons interested in any aspect of the many-faceted air-pollution problem. The 526-page book costs $1.75, and may be obtained from the U. S. Government Printing Office, Washington 25, D. C.

NBS—Four-Part Journal

The *Journal of Research of the National Bureau of Standards* is the basic medium by which the Bureau reports its findings to the scientific community. After July 1, 1959, NBS began to publish the *Journal* in the following four parts: Physics and Chemistry, bimonthly, $4 annually; Mathematics and Mathematical Physics, quarterly, $2.25 annually; Engineering and Instrumentation, quarterly, $2.25 annually; Radio Propagation, bimonthly, $4 annually. Each is available upon subscription from the U. S. Government Printing Office, Washington 25, D. C.

I. Mech. E.—Proceedings

"Proceedings of the Conference of Technology of Engineering Manufacture," held in London, England, March 25–27, 1958, are now available. The 672-page book is published by The Institution of Mechanical Engineers. Papers, reports, discussions, communications, and authors' replies are included on the subjects of forming and machining of materials and inspection techniques. Copies cost about $15, and may be obtained from I.Mech.E., 1 Birdcage Walk, Westminister, London, S.W.1, England.

Welding

Minutes of the Seventh Annual Atomic Energy Commission Welding Conference held in Chicago, Ill., November, 1957, are now available. Of particular interest are discussions relative to welding of 347 Stainless Steel and the welding problems encountered by AEC contractors. The 253-page book costs $2.50 and is obtainable from the Office of Technical Services, Department of Commerce, Washington 25, D. C.

Careers

- "Career: For The Experienced Engineer and Scientist" is a publication through which leading national employers highlight their job opportunities for experienced men. It features articles of special interest to engineers and scientists in the job market and special indexes which pinpoint the best employer prospects.

  Careers Incorporated, publishers, also make available to eligible applicants—ASME membership constitutes eligibility as does a degree from an ECPD-accredited institution—the National Manpower Register. This service matches electronically the qualification of a job applicant with the needs of leading employers. Members of ASME may apply for copies to: Careers Incorporated, 15 West 45th Street, New York 36, N. Y.
- ARDC. The Air Research and Development Command, United States Air Force, has as its mission the attainment and maintenance of qualitative superiority for USAF weapon systems, materiel, and techniques. For the accomplishment of these ends, ARDC employs 23,000 civilians, 4800 of whom are professional, scientific, and technical personnel. The organization has recently issued a brochure describing its "Career Opportunities for Scientists, Engineers, Administrators, and Technicians." Copies may be obtained from: Commander, Air Research & Development Command, Andrews Air Force Base, Washington, 25, D. C.

Increase Creativity?

"How To Increase Your Creative Output" is a new booklet developed specifically to help companies raise the level of creativity among their technical personnel. It is designed to be supplied by management to each member of the technical staff and provides practical guideposts for understanding the creative process and for increasing quantity and quality of creative work. The booklet is published by Industrial Relations News and is available at special quantity rates. Individual copies are $1.50. They may be ordered from Industrial Relations News, Book Department, 230 West 41st Street, New York 36, N. Y.

Personnel Management

"Personnel Management in Perspective," by Col. L. Urwick, British management consultant, tells how personnel management should be fitted into the business organization. It is Col. Urwick's thesis that personnel management should be integrated into the business with "line" managers making it one of their chief responsibilities. The pamphlet is Occasional Paper No. 13 of the Institute of Personnel Management, 80 Fetter Lane, London, E.C. 4, England. Cost is approximately 50 cents.

Business Investment Analysis

"An Introduction to Business Investment Analysis," by George Terborgh, is published by the Machinery and Allied Products Institute. The booklet introduces the reader to the MAPI method of investment analysis developed in a recent book on the subject by the same author. The method is a reliable technique for assessing the merits of individual investment proposals and for ranking them in the order of priority. Single copies of the pamphlet are available at 50 cents each from the Machinery and Allied Products Institute, 1200 Eighteenth Street, N. W., Washington 6, D. C.

Small Business Handbook

"Profitable Management for Main Street" is a Dun & Bradstreet Small Business Handbook. The booklet follows case histories of several small businesses, and illustrates many virtues and faults of small business management. Copies are available for $1 through any Dun & Bradstreet office in the U. S.

AMA Bookshelf

The AMA Management Bookshelf is the catalog of books and periodicals produced by the American Management Association. It is published annually. The 1959–1960 edition of the Bookshelf includes all publications released by AMA since the Fall 1958 catalog. For copies write American Management

Association, Inc., 1515 Broadway, New York 36, N. Y.

Atomic Industry Directory

The "1959 Atomic Industry Directory of Products, Equipment and Services" has been published by the Atomic Industrial Forum, Inc. Data-in-depth are provided through product and service "profiles" of more than 220 industrial organizations active in the development and utilization of atomic energy, including manufacturers, processors, architect-engineers and constructors, consultants, and suppliers of technical research services. Products, equipment, and services are listed under 40 major classifications and more than 130 subcategories. Copies of the 1959 Directory are available from the Atomic Industrial Forum, 3 East 54th Street, New York 22, N. Y.

Peaceful Uses of Atomic Energy

"Proceedings of the Second International Conference on the Peaceful Uses of Atomic Energy," held in Geneva, September, 1958, are now available. The 33-volume set, including a complete index, is divided into sections on materials, reactors, physics, chemistry, biology and medicine, and controlled fusion. For further information consult United Nations, Sales Section (PUAE, Room 814), New York, N. Y.

Automation

"Automation: Its Impact on Business and Labor," by John Diebold, proposes a concrete outline for exploring the social and economic consequences of the phenomenon in order to clear the air as to the real effects of automation. Publisher of the pamphlet is the National Planning Association, 1606 New Hampshire Avenue, N.W., Washington 9, D. C. In requesting copies, order Planning Pamphlet No. 106; cost is $1.

NACA Final Report

The "Forty-fourth Annual Report of the National Advisory Committee for Aeronautics, 1958," Final Report, covers the activities of the Committee through the close of business on Sept. 30, 1958, when it was superseded by the National Aeronautics and Space Administration. The report is for sale by the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C.; cost is $1.

Army Research Reviewed

"ARTS," the Annual Research Task Summary of the Army, giving information on the current status of more than 2300 Army research projects, has been placed in distribution channels by the Department of the Army. Six of the nine volumes of the summary have been released for public distribution. The titles and price of each of these follow: Vol. 1, Biological, Medical, Social, and Behavioral Sciences and Operations Research, $3.25; Vol. 2, Chemistry, $2; Vol. 3, Physics (Part 1), $3.50; Vol. 4, Physics (Part 2) and Mathematics, $3; Vol. 5, Geophysical Sciences and Engineering, $4.75; Vol. 6, Materials Technologies, $2.75. These may be purchased from the Office of Technical Services, Department of Commerce, Washington 25, D. C.

EJC Directory

"The Engineering Societies Directory," 1959 edition, is available from Engineers Joint Council. This Directory is the only comprehensive United States listing of engineering and scientific societies, their functional staff personnel, and publications. Societies and organizations are listed in the Directory as well as national and international organizations and all state registration boards for professional licensing. Copies which may be obtained from EJC, 29 West 39th Street, New York 18, N. Y., are $3.50.

EJC Newsletter

In its expanding service to the nation's engineers and its own member societies, Engineers Joint Council is publishing *Engineer*, a newsletter report on EJC activities, national affairs, and events which affect the engineer. *Engineer* will appear nine times a year. Distribution of the newsletter will be free and will be available to responsible persons and organizations in industry, government, and education. Address Engineers Joint Council, 29 West 39th Street, New York 18, N. Y. (See editorial p. 41.)

PEOPLE

Honors and Awards. Professor Rufus Oldenburger, Mem. ASME, School of Mechanical Engineering, Purdue University, has received the International Federation of Automatic Control award for meritorious service in promoting the science of automatic control among nations.

Sir George R. Edwards, internationally recognized aircraft designer, has been designated the Daniel Guggenheim Medal recipient for 1959.

Bruce H. Sage, professor of chemical engineering, California Institute of Technology, ordnance expert, and author, has been named recipient of the 1959 William H. Walker Award of the American Institute of Chemical Engineers. It is given annually to a member of AIChE who is the author or coauthor of an outstanding technical paper published by the Institute.

AIEE presented three medals to leading engineers for professional achievements. The Morris E. Leeds Award was presented to Herbert B. Brooks, of Washington, D. C., and the William M. Habirshaw Award went to William A. Del Mar, Yonkers, N. Y. The third award, the AIEE Medal in Electrical Engineering Education, was presented to Gordon S. Brown, dean of engineering, Massachusetts Institute of Technology, Cambridge, Mass.

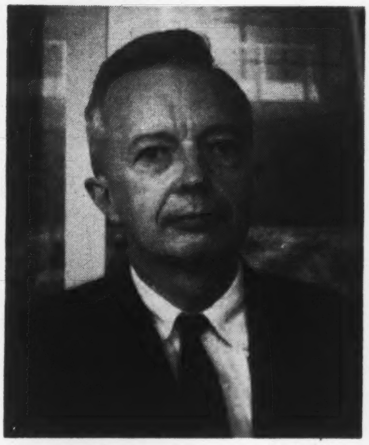
Hazel I. Quick, Commissioner on the Detroit City Plan Commission, was the first woman to receive an honorary DE degree from the Lawrence Institute of Technology. Miss Quick retired in 1950 after a distinguished career with the Michigan Bell Telephone Company.

Desiree Le Beau, Midwest Rubber Reclaiming, received the 1959 Award of the Society of Women Engineers. Presentation was made at the SWE annual convention held in St. Louis, Mo., in June, 1959.

Matthew A. Hunter, dean-emeritus, Rensselaer Polytechnic Institute, received the annual Doehler Award, the highest honor of the die-casting industry. The award was presented during the 1959 annual meeting of the American Die Casting Institute.

New Appointments. Harold Vagtborg, Mem. ASME, was elected executive chairman of the development council, and Martin Goland, Mem. ASME, was elected president of Southwest

Martin Goland



Dennistoun W. Ver Planck, Mem. ASME, head of electrical and mechanical engineering at Carnegie Institute of Technology, has resigned his faculty post to join the scientific staff at General Atomic Division, General Dynamics Corporation. He will join the San Diego, Calif., atomic research and development laboratory, February, 1960.

Research Institute, San Antonio, Texas. Dr. Vagtborg, who has served as president of the Institute since its founding in 1947, previously started Midwest Research Institute and Armour Research Foundation. He is also chairman of the board of Southwest Research Center which includes the two other organizations in the research complex. Martin Goland will continue to hold his present office of director of the Institute. Mr. Goland is also chairman of the committee on structural dynamics of NASA and is editor of *Applied Mechanics Reviews*.

Trustees who were elected to the development council include: Harold Boeschenstein, E. O. Buck, J. J. King, S. D. Kirkpatrick, N. C. McGowen, H. N. Mallon, W. J. Murphy, W. F. Rockwell, Jr., Mem. ASME, and General R. E. Wood.

Kenneth G. Picha, Mem. ASME, has been appointed as program director for Engineering Sciences in the Mathematical, Physical, and Engineering Sciences Division of the National Science Foundation. Dr. Picha has been professional assistant in the Engineering Sciences Program of the Foundation since September, 1958.

James H. Sams, Mem. ASME, and former vice-president ASME, has been unanimously elected to succeed T. Keith Legare as executive secretary of the National Council of State Boards of Engineering Examiners. Dr. Sams, who is dean of the school of engineering, Clemson College, Clemson, S. C., will take office on July 1, 1960.

New Officers. Carl F. Kayan, Mem. ASME, department of mechanical engineering, Columbia University, has been elected president of Commission II, Heat Transfer, Instrumentation, and Insulation, International Institute of Refrigeration (Paris).

Catherine Eiden, Illinois Bell Telephone Company, has been elected president of the Society of Women Engineers for the year 1959-1960.

Lauchlin M. Currie, vice-president in charge of the Atomic Energy division, The Babcock & Wilcox Company, has been named chairman of a five-man committee "to guide the destinies" of the annual Nuclear Congresses.

Others named to the committee are: J. R. Dunning, Mem. ASME, dean of the School of Engineering, Columbia University, New York; G. E. Holbrook, vice-president, E. I. du Pont de Nemours & Company, Inc., Wilmington, Del.; W. E. Kelley, president, Associated Nucleonics, Inc., Garden City, N. Y.; and C. R. McCullough, Monsanto Chemical Company, Washington, D. C. The 1960 Nuclear Congress will be held April 3–8 at the Coliseum in New York City.

Joseph L. Gillson, of Wilmington, Del., chief geologist of E. I. du Pont de Nemours & Company, Inc., has been elected president, for 1960, of the American Institute of Mining, Metallurgical, and Petroleum Engineers.

Engineers' Council for Professional Development has announced the election of its new officers. W. L. Everitt, dean of engineering, University of Illinois, has been re-elected president; R. A. Morgen, president, Rose Polytechnic Institute, has been elected vice-president. F. J. Van Antwerpen, secretary, AIChE, and E. P. Lange, Mem. ASME and secretary, EJC, were elected secretary and assistant secretary, respectively. Elected as chairmen of committees were: F. J. Jeffers, Mem. ASME, Guidance Committee; F. C. Lindvall, Mem. ASME, re-elected chairman, and N. A. Hall, Mem. ASME (vice-chairman), Education and Accreditation Committee; Maurice Graney, dean of engineering, University of Dayton, Subcommittee on Technical Institutes. Also named committee chairmen were: W. T. Alexander, Mem. ASME, Student Development; John Gammell, Affiliate ASME, and George Lobingier (vice-chairman), Westinghouse Electric and Manufacturing Company, Committee on Development of Young Engineers; Guy Savard, Canadian Liquid Air Company, Recognition; and W. W. Burton, Minnesota Mining and Manufacturing Company, Ethics.

Carleton C. Long, of Monaca, Pa., director of research, St. Joseph Lead Company, has been elected president of The Metallurgical Society of the AIME.

Arthur B. Cummins, manager of central research, Johns-Manville Corporation, has been elected president of The Society of Mining Engineers of AIME.

Albert M. Nutter, president of the Gray Iron Founders' Society, Cleveland, Ohio, was re-elected for another one-year term at the association's 31st annual meeting at the Fairmont Hotel, San Francisco, Calif., on October 7–9, 1959. Mr. Nutter is treasurer, E. L. LeBaron Foundry Co., Brockton, Mass.

Campus Data. George Gerard, Mem. ASME, and a member of the Executive Committee of the ASME Aviation Division, has been appointed associate director of the Research Division of New York University's College of Engineering. Dr. Gerard also is a research professor of aeronautical engineering in the College of Engineering.

Linn Helander, Fellow ASME, department of mechanical engineering,

R. V. Harris, supervising engineer, resonance equipment for Branson Instruments, Inc., Stamford, Conn., demonstrates a Vidigage Thickness Tester for a group of Yugoslav technicians. They are touring the United States to learn improved casting methods. Part of a five-week-long training program, the Branson visit was arranged by the U. S. International Co-operation Administration, Washington, D. C.

A. M. Beesing, **right**, winner of the $15,000 top professional award in the Steel Highway Bridge Design Competition sponsored by American Bridge Division, U. S. Steel, points out key features of his prize-winning design to A. J. Paddock, president of American Bridge. The competition which attracted 300 entries from this nation and abroad was conducted and judged under the auspices of the American Institute of Steel Construction. Object of the competition was "to stimulate more imaginative, effective, and economical use of modern, high-strength steels in overpass structures."

Kansas State University, Manhattan, Kan., has been appointed a visiting professor in heat engineering at the Aeronautical Institute of Technology at São Jose dos Campos, Brazil.

Helander is a Fellow in The American Society of Mechanical Engineers and has also been active in the American Society of Heating, Refrigerating, and Air-Conditioning Engineers. He also is a fellow in the American Association fot the Advancement of Science.

EDUCATION

Davidson Laboratory at Stevens

The Experimental Towing Tank at Stevens Institute of Technology was rededicated as the Davidson Laboratory and will enlarge the scope of its activities to carry on the name and traditions of its founder, the late Kenneth S. M. Davidson, Mem. ASME. A pioneer in hydrodynamic research with small models, Dr. Davidson founded the Laboratory in 1935 and became its first director.

The Davidson Laboratory has drawn up a program, the objectives of which include the addition of new facilities and working space for research, the establishment of a symposium to be held biannually on some aspect of hydrodynamics, the initiation of research projects which will broaden the scope of the Laboratory's efforts, and the establishment of grants and fellowships for basic research.

Heat-Transfer Research

Colleges, universities, and industrial research centers now can prepare for the study of liquid-metal heat transfer without expending valuable time in preliminaries such as designing and assembling the components for a high-temperature heat-transfer loop.

The answer is a "package" system similar to one recently installed in the chemical-engineering department of the State College of Washington, Pullman, Wash., under an AEC grant. MSA Research Corporation, Callery, Pa., is designer and manufacturer of the unit. The package is a complete circulation system ready to be put to work as soon as it is placed into position. Its special design features make it adaptable for a great variety of educational experiments and research investigations. Attesting to the usefulness of the apparatus is the fact that package loops will be installed at North Carolina State, Lehigh University, Purdue University, and Virginia Polytechnic Institute.

Educational Endowments

- The trustees of Newark College of Engineering have announced that Thomas M. Cole, president of Federal Pacific Electric Company, has donated $300,000 to the college for the establishment of a research foundation to assist the professional development of its graduate students and faculty.

The program will have as its three main objectives the creation of opportunities for the professional development of the teaching staff by providing them with broadly fundamental research activities in science and engineering; the attraction of capable young engineering graduates to the engineering teaching profession by offering them a combined program of education, teaching, and research; and the development of programs at the college to assist secondary school teachers of science and mathematics in their own professional advancement.

- A gift of $50,000 from the Cesare Barbieri Endowment to endow a fluid machine laboratory in the new Cooper Union School of Engineering building has been announced. Dr. Barbieri was a mechanical engineer, inventor, and philanthropist who died in 1956.

Research Reactors

The Atomic Energy Commission, under its research reactor assistance program, is providing nuclear materials assistance grants to educational institutions throughout the nation. Most recent recipients of grants are:

- University of Buffalo—Permit for construction of one-megawatt pool-type research-reactor, $30,764 for fabrication of 32 fuel elements containing approximately 5 kg of U-235, and a neutron source for use in the reactor.
- University of Illinois—$150,000 toward construction of Nuclear Research and Training Center which will house a 10-kw Triga reactor.
- University of Michigan—fuel elements to augment the present core loading of the University's Ford Nuclear Reactor, $24,400 for fabrication of 32 fuel element containing approximately 4.5 kg of U-235.
- Texas A&M—$26,718 for fabrication of 35 fuel elements containing approximately 4.5 kg of U-235, and $3250 for fabrication of neutron sources to be used in a pool-type research reactor scheduled for completion early in 1961.

Nucleonics Training

Designed to fill an informational and training gap in the field of nucleonics, a new firm, Radiation Engineered Services, Norristown, Pa., has been formed. The firm has assembled an experienced staff and is offering a series of training programs in the nuclear field. The programs are designed to assist in obtaining AEC licenses for possession of radioisotopes as well as for those who are only incidentally interested in the field. Registration is limited to 40 persons; fees for a one-week course are $150.

Carnegie Tech to Get New Building

A gift of $1¼ million from the Sarah Mellon Scaife Foundation will make pos-

(*Continued on page 118*)

Notes on
Society Activities
and Events

E. S. NEWMAN
News Editor

THE ASME NEWS

ASME Technology Executives Briefed at Arden House

The seventh Technology Executives' Conference of the ASME was held at Arden House, Harriman, N. Y., Oct. 11–13, 1959. This is the conference at which the incoming chairman of each professional division and the new member of his executive committee receive indoctrination, a briefing on Society policy and procedure. In addition, the conference serves as a forum to discuss problems of the Board on Technology, questions concerning meetings, publications, research, and the professional divisions.

Attending the conference were ASME's President, President-Elect, Regional Vice-Presidents, newly elected Members of the Council, the new Division Chairmen, the new members of the Executive Committees of the Divisions, and staff personnel including the Secretary, Senior Assistant Secretary, the Assistant Secretaries and the Editor, and others representing the Technological Services.

At the introductory session, held on the evening of October 11, R. C. Allen of Allis-Chalmers, Chairman of the Board on Technology, opened the meeting, explaining the purposes of the Technology Executives' Conference.

Productivity and the Societies

President Warren then addressed the session, "To call the shots as I see them after ten months in office." By way of general orientation, Mr. Warren pointed out that the explosive increase in productivity began about 1870, at the time when engineering societies were starting, and that there was a direct connection between the two events. The societies disseminated technical information that previously had been hoarded as "trade secrets."

Another point made by the President concerned the factor of innovation, of great concern to industry. The inventor—the individual innovator—is still the primary source of new ideas. A recent survey of outstanding innovations showed 26 by individuals, 18 by teams in industry, and 10 which were indeterminate. The outsider is still most likely to produce the innovation.

President-Elect Walker L. Cisler spoke briefly on a subject that is close to him, and on which he has special knowledge. To the suggestion that we take an active part in promoting air raid shelters, he urged that we work toward closer contact with Russian engineers, to the end that atomic war may be averted—prevent war, rather than hide from it. Mr. Cisler has visited Russia on missions for the State Department. His belief that engineers of the two countries can contribute to a meeting of minds that will avert atomic destruction, carries the authority of first-hand observation.

On October 12, at 9 a.m., the conference assembled for its first briefing from Senior Assistant Secretary T. A. Marshall, Jr. He used the Meetings, Professional Divisions, and and other Manuals as the basis of his instruction. Most of these manuals are available to the entire membership without charge (Mechanical Engineering, Oct. 1959, p. 134). Later in the day, the session was taken over by Meetings Manager A. Bruce Conlin, who instructed the meeting in the operation of his department and its relation to national meetings and division conferences.

On October 13, the conference was thrown open for debate on the methods and procedures to be followed in the coming year. These discussions were essentially off the record, but certain points that were brought out will be of interest to all members of the Society.

Divided Opinion

For example: The need to reduce conflicting sessions within conferences: The man who called politics the "art of the possible" would have appreciated the debate that developed around these issues. There was a body of opinion holding that we must have fewer papers of higher average quality, thus reducing the number of sessions and the number of conflicting sessions.

As always at these executive conferences, there was debate on the conduct of technical sessions, the need to provide more time for discussion of papers. Certain other societies prohibit the reading of whole papers by their authors, limiting them to five or ten-minute rèsumès of their papers. This requires, of course, that all papers be in the hands of the audience well in advance—perhaps a month in advance. This would push back the deadlines: But would it result in more rewarding technical sessions?

The Student Member

Imaginative leadership is needed to bring to our student members the realization that their main success in life will be in relationship to their membership in ASME—just as our future ultimately rests with them. The Oil and Gas Power Division reported that it is underwriting a competition among student members for the best technical paper in its field.

Upgrade Your Membership

Division Chairmen and Regional Vice-Presidents were urged to make every effort to induce Associate Members to upgrade their membership as soon as they are qualified. (There is no longer a special fee for transfer of grade.) Tom Marshall told the classic story of the outstanding engineer who remained an Associate and liked to boast that he was the Society's oldest in grade. Then a group of his colleagues proposed him for the honor of Fellow. Our constitution requires 13 years of full membership before Fellowship can be conferred.

Moral: Do as this man then did. Send in your application for full membership, forthwith.

ASME COMING EVENTS

November 4–6

ASME-IRE-AIEE-ISA National Automatic Control Conference, Sheraton Hotel, Dallas, Texas

November 8–13

ASME-ASTM-ACS International Rubber Conference, Shoreham and Park Plaza Hotels, Washington, D. C.

November 29–December 4

ASME Annual Meeting, Chalfonte-Haddon Hall, Atlantic City, N. J.

March 6–9, 1960

ASME Gas Turbine Power and Hydraulic Conference, Rice Hotel, Houston, Texas

March 14–15, 1960

ASME Lubrication Symposium, Engineering Societies Building, New York, N. Y.

March 31–April 9, 1960

ASME Textile Engineering Conference, North Carolina State College, Raleigh, N. C.

April 4–8, 1960

Nuclear Congress and Exhibit, Coliseum, New York, N. Y.

April 13–14, 1960

ASME-AIEE Railroad Conference, Penn-Sheraton Hotel, Pittsburgh, Pa.

April 21–22, 1960

ASME-SAM Management Conference, Statler Hilton Hotel, New York, N. Y.

April 25–26, 1960

ASME Maintenance and Plant Engineering Conference, Chase-Park Plaza Hotels, St. Louis, Mo.

April 25–29, 1960

ASME Metals Engineering Division-AWS Conference, Hotel Biltmore, Los Angeles, Calif.

May 17–19, 1960

ASME Production Engineering Conference, Hotel Schroeder, Milwaukee, Wis.

May 22–26, 1960

ASME Oil and Gas Power Conference and Exhibit, Muehlebach Hotel, Kansas City, Mo.

May 23–26, 1960

ASME Design Engineering Conference and Show, Statler Hilton Hotel, New York, N. Y.

June 5–10, 1960

ASME Semi-Annual Meeting and Aviation Conference, Statler Hilton Hotel, Dallas, Texas

June 20–22, 1960

ASME Applied Mechanics Conference, The Pennsylvania State University, University Park, Pa.

August 15–17, 1960

ASME-AIChE Heat Transfer Conference and Exhibit, Statler Hilton Hotel, Buffalo, N. Y.

September 7–9, 1960

ASME Instrument and Regulators Conference, Massachusetts Institute of Technology, Cambridge, Mass.

September 15–16, 1960

ASME Engineering Management Conference, Morrison Hotel, Chicago, Ill.

September 21–23, 1960

ASME-AIEE Power Conference, Bellevue-Stratford Hotel, Philadelphia, Pa.

September 26–28, 1960

ASME Petroleum Mechanical Engineering Conference, Jung Hotel, New Orleans, La.

October 9–12, 1960

ASME Rubber and Plastics Conference, Lawrence Hotel, Erie, Pa.

October 10–11, 1960

ASME-AIEE Fuels Conference, Daniel Boone Hotel, Charleston, W. Va.

October 17–19, 1960

ASME-ASLE Lubrication Conference, Statler Hilton Hotel, Boston, Mass.

November 27–December 2, 1960

ASME Annual Meeting, Statler Hilton Hotel, New York, N. Y.

(For Meetings of Other Societies see page 127)

Note: Members wishing to prepare a paper for presentation at ASME National meetings or divisional conferences should secure a copy of Manual MS-4, "An ASME Paper," by writing to the ASME Order Department, 29 West 39th Street, New York 18, N. Y., for which there is no charge providing you state that you are a member of ASME.

Three Nobel Prize Winners Speak at Cooper Union's Centennial Convocation

Three Nobel Prize winners were among the internationally known authorities on science, art, government, and education who participated in an academic convocation on "New Values in Science, Art, and Society" given by The Cooper Union as part of its year-long centennial observance.

The convocation was held throughout the day on Nov. 2, 1959, which marks the actual 100th anniversary of the formal opening of Cooper Union in 1859. The morning and afternoon sessions were held in the Great Hall of Cooper Union's Foundation Building, and the evening session in the grand ballroom of the Waldorf-Astoria Hotel, New York City.

The convocation began at 10 a.m. with an academic procession around the century-old Foundation Building at Eighth Street between Third and Fourth Avenues, Manhattan. Entrance of the procession into the Great Hall signaled the opening session, at which Dr. Laurence M. Gould, president of Carleton College, Minnesota, spoke on "Education and Society."

The afternoon session was devoted to discussions on "Science, Art, and Society." Sir Kenneth Clark, chairman of the Arts Council of Great Britain, delivered an address on "Art and Society." His talk was followed by discussions of "Science and Society" by Sir John Cockcroft, member of the United Kingdom Atomic Energy Authority and a winner of the Nobel Prize for Physics, and Dr. Harold C. Urey, noted American scientist and winner of the Nobel Prize for Chemistry.

Lester B. Pearson, former president of the General Assembly of the United Nations and a winner of the Nobel Prize for Peace, spoke on "Government and Society" at The Cooper Union's 100th birthday dinner in the evening at the Waldorf-Astoria.

In announcing the convocation, Dr. Edwin S. Burdell, president of the institution, noted that the meeting was designed as an inquiry into the present and future potentials of the fields of education Cooper Union serves.

"Today," said Dr. Burdell, "The Cooper Union looks forward, as did its founder, to a new century. In the century ahead, however, society may depend more than ever before upon the scientist for shaping its material environment and probing the mysteries of the universe, and upon the artist for interpreting truth and expressing life's meaning.

"It is anticipated that this academic gathering will encourage the expression of new values in science, art, and society which will condition and ameliorate future human experience and help, in the words of the Founder, 'to open the volume of knowledge by the light of truth' for a new generation."

Serving on the Centennial Committee are Herbert Hoover, honorary chairman, and the following honorary vice-chairmen: Bernard M. Baruch, Ralph J. Bunche, Henry F. du Pont, James A. Farley, Herbert M. Lehman, Alfred P. Sloan, Jr., Charles E. Wilson, and Owen D. Young.

Arthur A. Houghton, Jr., a Cooper Union trustee, is chairman of the Planning Committee.

H. A. McKeever, Mem. ASME, general chairman, Wood Industries Conference, discusses program with W. C. Ring, FPRS, **left,** in charge of the technical program; and L. P. Growney, FPRS, **right,** in charge of arrangements and publicity

ASME-FPRS-AIChE Explore Technology . . .

W. C. Heath, ASME Vice-President Elect, addresses Wood Industries Conference

Rex Reynolds, **Mem.** ASME, and chairman, Wood Industries Division, addresses a luncheon group. Seated at head table are, **left to right,** Portland Mayor Terry Schrunk; E. H. Clarke, U. S. Department of Agriculture; B. W. Wright, Assoc. Mem. ASME; and R. L. Boals, Mem. ASME.

. . . at Portland, Oregon, Conference, September 10–12, 1959

Nationally known specialists in the fields of mechanical engineering, chemical engineering, and forest products research pooled their talents for the unique Wood Industries Conference at the Multnomah Hotel in Portland, Ore., September 10–12. The assembled group—more than 270—took a thorough look at trends and new developments in their field. Program for the meeting was a joint effort of the Wood Industries Division and Oregon Section of The American Society of Mechanical Engineers; Pacific Northwest and Inland Empire Sections of the Forest Products Research Society; and the Washington-Oregon and Southwest Washington Sections of the American Institute of Chemical Engineers.

Wood Chips

Seven technical sessions spotlighted such topics as management problems, materials handling, chemistry in wood utilization, and foundations for profitable research. Economic pressure in the Northwest has developed the need for greater utilization of wood products with emphasis on research and development. The joint nature of the conference made it possible to focus attention on a number of aspects of this theme.

A unique summarization period concluded the conference. Prominent members of each of the participating societies provided analyses, impressions, and criticisms of the papers and discussions. Summaries were directed toward wood and wood products, how they rate in comparison to competitive materials, and what the future holds for them.

This summation session was held on the Oregon Centennial Grounds in the futuristic Forest Products Pavilion—a visible symbol of new techniques in wood construction. The 24,000-sq ft structure is comprised of seven hyperbolic paraboloids each 50 × 50 ft sq, separated by 5-ft-wide plastic skylights. Most unusual feature of the pavilion is that it is constructed of wooden 1 × 6's secured to each other with staples. Lamination of the shells was done high above the ground through the use of forms and shoring.

No Dead Wood

Rex Reynolds, chairman, ASME Wood Industries Division, in a luncheon address, contributed some "Ideas—Subject to Change Without Notice." Mr. Reynolds reviewing the technological advances in our era harked back to the day when many of these were little more than a flash of the pen of the science-fiction writer. He pointed to the "idea bank," a bequest of the ages, and suggested not only that we draw on it but stay alert to changing ideas—making our own deposits, earning new interest. "Looking backward," he said, "and taking the bow or the pat on the back which you so richly deserve, can at the same time give you a certain degree of overconfidence that in this day of rugged competition could be disastrous. Stay alert to changing ideas and make the next 100 years more prosperous than the last."

Out of the Woods

Plant inspection trips offered visitors an opportunity to see some of the leading industries in the Portland area. Conferees interested in laminated products, pulp and paper, plywood and lumber, fabricating of wood products, or plant equipment had a choice of plant tours.

The General Committee for the meeting hopes that this joint conference will encourage more intensive dissemination of technical effort by each of the participating societies. It is suggested that in this way wood, one of our prime natural resources, will have its economic value extended.

Proceedings of this conference are available in a 235-page text (without discussions) at a cost of $3. Orders may be placed through Mr. Edward H. Clarke, Forest Utilization Research, U. S. Department of Agriculture, P. O. Box 4059, Portland, Ore.

UEC *(Continued from page 106)*
gineering professions can provide," Mr. Thompson concluded.

Others who participated in the ceremony included Andrew Fletcher, president of United Engineering Trustees, Inc.; R. E. Dougherty, chairman of the Member Gifts Campaign Committee; and Mervin J. Kelly, chairman of the Industrial Building Fund Committee.

The Benediction was pronounced by Rev. John J. O'Reilly of Holy Family Church, East 47th Street, New York City.

When completed in 1961, the Center will be occupied by the following groups: American Society of Civil Engineers; American Institute of Mining, Metallurgical and Petroleum Engineers; The American Society of Mechanical Engineers; American Institute of Electrical Engineers; American Institute of Chemical Engineers; American Society of Heating, Refrigerating and Air-Conditioning Engineers; Illuminating Engineering Society; American Institute of Consulting Engineers; American Welding Society; American Institute of Industrial Engineers; Society of Women Engineers; The Municipal Engineers of the City of New York; United Engineering Trustees, Inc.; Engineering Societies Library; Engineering Foundation; Welding Research Council; Engineering Index; Engineers' Council for Professional Development; and Engineers Joint Council.

Shreve, Lamb & Harmon Associates are the architects. Seelye, Stevenson, Value and Knecht are the structural engineers, Jaros, Baum & Bolles the mechanical and electrical engineers. General contractor is Turner Construction Company.

Education *(Continued from page 114)*
sible a new engineering building for Carnegie Institute of Technology.

The new building, to be known as the Alan M. Scaife Hall of Engineering, will be erected adjacent to the present Engineering and Science Hall. It will furnish space for the further expansion of graduate work and research in physics and metallurgical engineering, besides offering more room for vital research in engineering materials. Increased enrollment in graduate studies will now be possible.

An important feature of the building will be a nuclear science and engineering laboratory. This facility will serve to strengthen a recently initiated nuclear program at the graduate level. This is a joint activity of all departments in the College of Engineering and Science, especially physics and mechanical engineering.

Mass Spectrometer for Clemson

The Olin Foundation, Inc., has presented Clemson College with a $63,000 mass spectrometer to "greatly increase" the research potential of the institution.

The unit will be invaluable to the work of the departments of chemistry and physics of the School of Arts and Sciences, and in all departments of the Schools of Engineering, Agriculture, and Textiles. It will be located in the Samuel Broadus Earle Chemical Engineering Building.

Dr. J. H. Sams, Mem. ASME, dean of the School of Engineering, said that the mechanical-engineering department will now be able precisely to determine engine performance by analysis of entering and existing liquid and gas streams, and departments of ceramic engineering and metallurgy will be able to follow the path of reactions in the solid state by analysis of off-gas streams.

NSF Funds for "Quenching"

Columbia University has received a grant of $54,000 from the National Science Foundation to further research in the fundamentals of hardening steel.

The program, headed by Dr. Victor Paschkis, Mem. ASME, director of the Heat and Mass Flow Analyzer Laboratory in the University's Department of Mechanical Engineering, may make possible the employment of low-alloy steels in various uses at a considerable saving.

NSF Summer Programs

The National Science Foundation announces that it will continue to support the following programs during the summer of 1960 and the academic year 1960–1961: Undergraduate Research Participation, Research Participation for Teacher Training, and Science Training for Secondary School Students.

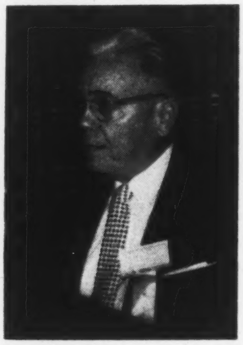
Colleges, universities, and other educational institutions desiring to consider participation in these programs may receive full information by addressing: Special Projects in Science Education, Scientific Personnel and Education, Washington 25, D. C.

97 Earn NYU-Bell Labs MS

The first engineers to enter Bell Laboratories' unique educational program, run in co-operation with New York University, won their MS degrees this month.

The 97 men in the class were awarded their diplomas for completing the two-year advanced study program at the N.Y.U.-Bell Laboratories graduate center, Murray Hill, N. J.

Engineering Resources—



President Warren: "...management as an art is very, very old..."

"Managing Engineering Resources" was the theme of the seventh annual Engineering Management Conference held at the Statler Hilton Hotel, Los Angeles, Calif., September 17–18, 1959. Sponsored jointly by the ASME Management Division and the AIEE Committee on Management, the conference had the co-operation of ASCE, AIIE, AIChE, the Metallurgical Society of AIME, their local sections, and the IRE Los Angeles Section.

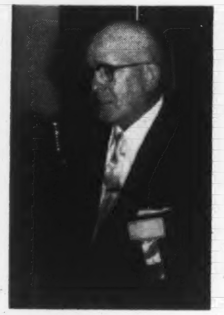
The meeting was designed to serve engineering managers and young management-minded engineers. Its aim was to improve their understanding of the relationship which must exist between engineering and management to provide for the welfare of the individual, the organization with which he is connected, and this country as it establishes its role in the world picture.

ASME President Warren Speaks

In a luncheon address, G. B. Warren, ASME President, delineated "Some Problems That Face the Engineering Profession in the Management Field." In stating why engineers must be concerned with management, he said, ".... throughout an engineer's career he is either being managed, or managing, and in reality in many cases both, or in other cases he is aiming at or has arrived at a career in specific or in general management, for which in many kinds of industry he is well fitted. Certainly, the effectiveness of his work, his happiness, and rewards therein will depend greatly upon the quality of the management environment in which he participates."

Further, ".... concern with the man-

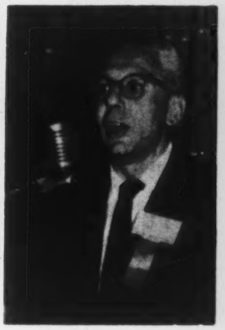
How to Manage : . . .

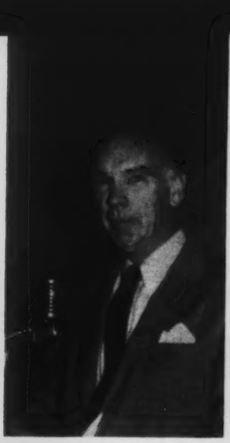


Honorable George D. Clyde, Governor of the State of Utah

D. D. Acker, Mem. ASME, Conference Steering Committee Chairman

H. O. Fuchs, Mem. ASME, presides at luncheon





Kenneth McFarland, General Motors, tells of "The MAN in MANagement"

Hugh A. Bogle, Mem. ASME, Engineering Societies Joint Committee Chairman

. . . Topic of Engineering Management Conference at Los Angeles, September 17–18

agement and administration of engineering itself has been greatly increased of late by the growing complexity and magnitude of the scientific and engineering projects and enterprises of the dynamic age in which we live. Whereas forty years ago an engineer dealt in problems involving perhaps ten to a hundred people and thousands to a few millions of dollars, and generally of relatively simple technical level, today his problems are frequently from ten to a hundred times greater in magnitude, complexity, risk, and depth of technology."

President Warren added, ". . . .many of our management problems and strains in the engineering field are being brought about because—due to the complexity and growth of the engineering problems in many large, modern businesses, particularly in the heavy machinery field, in the defense, in the newer electronic, aeronautic, computer, power, and nucleonic fields—these businesses cannot any longer be said to be organized and run solely for the profit-making functions, but they must be more service and product-oriented. They become, therefore—or at least parts of them—more nearly like the 'professional organizations' . . . . and must be more largely headed and guided by the professional or expert-oriented man."

At the Sessions

Four sessions of the conference were as much concerned with the general aspects of managing engineering resources as they were with specific details of engineering controls and engineering planning.

Major concern was with the development of engineering managers. A philosophy of engineering management was set forth. Inherent in this philosophy is the engineer-manager's responsibility to continue to stimulate those vital characteristics of curiosity, imagination, and noble discontent which mark professional engineers by building the kind of co-operative climate in which the engineer can find creative fulfillment.

While the general approach to management problems is often identical in different situations, in certain areas a new set of problems arise. For this reason, the question of developing engineer-managers in defense industries and in government was considered.

The increasing complexity of engineering systems has outmoded planning and control techniques of old and a need has grown for effective tools to control the engineering function. That improved information and its manipulation by formal disciplined means are such tools was emphasized. In this connection, mention was also made of linear programming, queueing theory, human factors research, decision theory, information theory, the computers with their large memories, high-speed printing equipment, and devices capable of fast reproduction of records from drawings to calculations.

New techniques associated with operations research and advanced mathematics have also become vital forces in engineering decision making.

The tools are available; it remains only for the engineer and the manager to see that these resources are tapped in order that the engineer may be freed from routine to the exercise of ingenuity and more creative engineering.

An availability list of papers presented at this meeting follows. Digests of all papers which are not scheduled for publication in Mechanical Engineering will appear in the "ASME Technical Digest" in this or a forthcoming issue of Mechanical Engineering.

Availability List—ASME-AIEE Engineering Management Conference

The papers in this list are available in separate copy form until July 1, 1960. Please order only by paper number; otherwise the order will be returned. Copies of these papers may be obtained from the ASME Order Department, 29 West 39th Street, New York 18, N. Y. Papers are priced at 40 cents each to members; 80 cents to nonmembers.

Payment may be made by check, U. S. postage stamps, free coupons distributed annually to members, or coupons which may be purchased from the Society. Coupons, in books of ten, are $3 to members; $6 to nonmembers.

59—Mgt-1 Developing Managerial Abilities, by F. F. Bradshaw

59—Mgt-2 New Methods of Engineering Decontrol, by H. H. Goode

59—Mgt-3 The Philosophy of Engineering Management, by J. L. Young

59—Mgt-4 Development of Engineering Managers in Governmental Organizations, by B. S. Grant

59—Mgt-5 Development of Engineer-Managers in Industry, by J. L. Atwood

59—Mgt-6 Decision Making in Engineering, by W. T. Nichols and R. E. Heitman

59—Mgt-7 Planning and Control in Engineering Management, by N. J. Ream

59—Mgt-8 Some Aspects of Control of the Engineering Function, by J. S. Sayer

59—Mgt-9 Engineering Programs for New Frontiers, by G. P. Sutton

T. L. White, chairman, Petroleum Executive Committee

J. P. Mooney, vice-chairman, Petroleum Executive Committee

Harold Grasse, Vice-President, ASME Region VIII

E. W. Jacobson, a Director of ASME, long-time "Petroleumer'

Petroleum Industry Influences the Progress of Civilization Says President Warren at Houston Conference

900 engineers attend ASME Petroleum Meeting; hear about sonic pump; 50,000-ft drilled hole

President Warren, G-E. executive, tells how petroleum industry relies on many skills and the interchange of knowledge for its effectiveness and efficiency

James C. Shaw, retired engineer, of Houston, Texas, receives 50-year membership pin from President Warren

THE effects of the petroleum industry are no longer confined to use as fuel for transportation, or home, or industry, but "is opening up a whole new family of chemical processes and chemical products that in turn may work revolutions in many of the things which we do," said Glenn B. Warren, ASME President, of the influence of the petroleum industry on the progress of civilization.

Warren Addresses Welcome Luncheon

Mr. Warren, a General Electric Company vice-president and consulting engineer—Turbine Division, discussed the industry which this year celebrates its 100th Anniversary and the areas in which ASME can be of even more service and value. He spoke before the Welcome Luncheon audience, held during the 14th annual Petroleum Conference of The American Society of Mechanical Engineers at the Rice Hotel, Houston, Texas, September 20–23.

The effectiveness and efficiency with which the petroleum industry is carried out, Mr. Warren said, is all dependent upon the skill of the scientists, engineers, and management, and, to a great degree, to the extent to which you can interchange information, knowledge, and discoveries as to better methods and processes, one with another.

The Petroleum Division of the ASME, said Mr. Warren, was one of the earliest Divisions that recognized that its problems were different and unique from the problems confronting many of the other Divisions of ASME, and established the practice of the Petroleum Conference. Looking at this and its success, many other Divisions and the administration of ASME decided that this should be a better way of life for the entire Society.

"In other words," said Mr. Warren, "The Petroleum Division was one of the early Divisions that pointed the way toward the present decentralization of the ASME into 25 Divisions."

Discussing the strength of decentralization, Mr. Warren cautioned that there is also an attending element of weakness; unless specific steps are taken to avoid it, there is a great loss in the cross fertilization that one line of activity can give another.

"This can only be offset," he said, "by a deliberate system of cross fertilization and to a very great degree this we have done in the publication system of the Society through a much improved MECHANICAL ENGINEERING magazine coming out monthly.

"This magazine," he stated, "carries synopses throughout the year of a large number of all of the papers presented to the ASME it carries the progress of all of the general national meetings and the Professional Divisions meetings, and it carries articles of major interest. A recent rearrangement of Transactions into five major groups permits a still further dissemination of the most important papers presented each year to a group of members who are sufficiently interested to spend the time and money required to get these Transactions publications."

While Mr. Warren paid tribute to the outstanding job done by the Petroleum Division, he pointed out many important activities in other areas of the ASME which are making and will make important contributions to the petroleum industries if properly integrated into the mechanical-engineering phases of the petroleum industry. He reviewed the work of several of the Professional Divisions dealing with land and marine steam-power plants, reciprocating oil and gas engines, and prime movers. He covered fuels, lubrication, and production processes; mentioned instruments and regulators and maintenance and plant engineering and how this work can contribute to increasing process plant output and decrease maintenance and operating costs. He stressed the work being done in Codes and Standards as it relates directly and indirectly to the petroleum industry as well as the accomplishments in research.

In conclusion, Mr. Warren discussed the importance of the work being done by the Society through Engineers' Council for Professional Development and the Engineers Joint Council and what this work means to the petroleum industry.

An outstanding feature of the Luncheon was the presentation of the 50-year membership pin to James C. Shaw. Mr. Shaw graciously spoke a few words of encouragement to the "young" men who are following him in a "gratifying" profession.

The Petroleum Conference was welcomed to Houston by George Montgomery, Councilman and Pro Tem Mayor. Harold Grasse, Vice-President, ASME Region VIII responded. J. H. Colby presided and P. G. Reeve made the introductions of the honored guests.

Scope of Technical Papers

The technical papers, presented in 22 sessions, were classified in five categories: Drilling and production; manufacturing; materials; refining, gas products, and petrochemical; and transportation. Two panel discussions rounded out the program. They dealt with the pressure vessel code and piping code.

Some of the material presented in the papers discussed the sonic pump, which uses sound waves in the range so high they cannot be heard by the human ear to operate the units. Another was about drilling 50,000-ft holes. Remote-control systems for gas pipelines were described as were automatic computers for dispatching product pipelines.

A new subsurface surveying tool is now being used to determine the size and shape of underground caverns in which to store liquefied petroleum gas and other petroleum products. The new tool is lowered into the cavern through a well bore where it emits directional sound impulses and measures the time interval elapsing until the echo, reflected from the cavern wall, is received. Recordings are taken at successive depth intervals, and the profile of the cavern is thus determined. The new tool provides a rapid, accurate method of determining the size, shape, and orientation of underground caverns resulting from solution-mining operations or as utilized for underground storage of petroleum production.

Another paper discussed the metering of crude oil with a turbine. The key to metering crude oil accurately with a turbine is holding the turbine "slip" constant over wide range of flow and viscosities. This was accomplished by incorporation of a universal viscosity compensator without sacrificing any of the advantages of turbine metering; vis., mechanical simplicity, perfect running balance, and low bearing loads. The compensated meter can be calibrated just once regardless if the measured liquid is as light as gasoline or as heavy as viscous motor oil.

Any engineer—male or female—who ever had to wash and dry a china dish may take a jaundice view of the following: "Ceramics have more strength and wear resistance for many applications in the oil producing industry than any other material known."

Ceramics are now being used for orifice chokes and mud-gun nozzles, valve parts, rock bit jet nozzles, and other kinds of orifice liners. These are parts subject to excessive wear.

An availability list of papers presented at this meeting follows. Digests of all papers which are not scheduled for publication in MECHANICAL ENGINEERING will appear in the "ASME Technical Digest" in this or a forthcoming issue of MECHANICAL ENGINEERING.

More than 950 petroleum engineers, their wives, and guests attended the conference and the social program that included a "Get Acquainted" reception, a buffet dinner and dance, industry luncheons, and the banquet.

Availability List—Petroleum Conference

THE papers in this list are available in separate copy form until July 1, 1960. Please order only by paper number; otherwise the order will be returned. Copies of these papers may be obtained from the ASME Order Department, 29 West 39th Street, New York 18, N. Y. Papers are priced at 40 cents each to members; 80 cents to nonmembers. Payment may be made by check, U. S. postage stamps, free coupons distributed annually to members, or coupons which may be purchased from the Society Coupons, in books of ten, are $3 to members; $6 to nonmembers.

59—PET-1 Overstrain Tests on Thick-Walled Cylinders, by S. M. Jorgensen
59—PET-2 Edge Influence Coefficients for Toroidal Shells of Positive Gaussian Curvature, by G. D. Galletly
59—PET-3 Edge Influence Coefficients for Toroidal Shells of Negative Gaussian Curvature, by G. D. Galletly
59—PET-4 50,000 Feet Downhole—In a Modern Laboratory, by R. Q. Fields and M. Lebourg
59—PET-5 Materials Used in Railroad Tank Cars, by C. T. Graves
59—PET-6 Cooling-Tower Specification and Design, by G. M. Anderson
59—PET-7 Metering Crude Oil With a Turbine, by Henning Karlby and W. P. Z. Lee
59—PET-8 Materials and Construction for Subzero Temperature Service, by Milo Palmer
59—PET-9 Gas Turbines, Installation and Operational Problems and Performance Evaluation, by Charles Bultzo
59—PET-10 Use of Computers in Scheduling for Products Pipe Lines, by C. A. Stapleton
59—PET-11 A New Design Concept for High-Horsepower Reciprocating Pumps, by C. H. Rose
59—PET-12 Welding of X56 Pipe, by N. F. Blundell
59—PET-13 Heavy Crude-Oil Production Problems—A Challenge to the Mechanical Engineer, by E. W. Walker
59—PET-14 Sonar Caliper Surveys of Underground Caverns, by G. D. Patterson and S. G. Williams
59—PET-15 An Analytical Study of Drill-String Vibration, by J. J. Bailey and I. Finnie
59—PET-16 An Experimental Study of Drill-String Vibration, by I. Finnie and J. J. Bailey
59—PET-17 Selection and Use of Precipitation Hardening Stainless Steels, by M. E. Holmberg
59—PET-18 The Sonic Pump for Wells, by G. A. Bodine
59—PET-19 Rationalization of Drilling—Rig Power Plants, by W. S. Crake
59—PET-20 Two-Stage Centrifugal Pipeline Compressor, by E. W. Tanzberger and H. O. Jacobi
59—PET-21 The Derivation and Programming of Equations for Calculation of Centrifugal-Compressor Performance on an Electronic Computer, by M. G. Wallington
59—PET-22 Flow Equation for Gas Transmission Pipelines, by E. Gordon
59—PET-23 Simplified Approach to Understanding the Suction Problems for Reciprocating Mud Pumps, by W. E. Liljestand
59—PET-24 Methods of Displacement in Multiple—Tubing String Wells, by W. W. Word
59—PET-25 Specially Designed Equipment for Engineering Test Laboratory by C. E. Anderson and R. A. Gulick
59—PET-26 Design of Pipe Supports for Petrochemical Plants, by Bruno Laan
59—PET-27 Factors Governing the Design and Use of Air Fin Coolers, by H. N. Worsham
59—PET-28 Water Treatment and Cooling Tower Maintenance, by P. G. Ketcham
59—PET-29 Structural Verification of Pressure Equipment, by G. P. Eschenbrenner and C. H. Honigsberg
59—PET-30 The Development and Testing of a High-Temperature Oil Well Drilling Fluid, by J. C. Cowan
59—PET-31 Cooling System Operation and Maintenance, by M. J. Crowley
59—PET-32 Fundamentals of Low-Temperature Insulation, by R. L. Anderson, Jr.
59—PET-33 The Use of Internal-Combustion Engines on Pipelines, by J. M. Monroe
59—PET-34 Progress Report on Welded Repairs to API 5LX52 Pipe, by T. A. Ferguson
59—PET-35 Magnetic-Type Mechanical Seals, by Abbott W. Lighter
59—PET-36 Prevention of Sulfide-Stress Cracking in Sour-Condensate Well Equipment, by W. J. McGuire and L. W. Vollmer
59—PET-37 Materials for Equipment Operated Below Minus 100 F, by O. A. Hansen
59—PET-38 Brake-Block Requirements for Oil-Field Drilling and Servicing Rigs, by F. W. Barton, Jr.
59—PET-39 A Study of Wells Producing Through Small Conduits, by C. V. Kirkpatrick
59—PET-40 Practical Applications for High Strength Ceramics in the Petroleum Industry, by B. D. Landes
59—PET-41 Equipment Requirements for Air and Gas Drilling, by F. W. Smith
59—PET-42 Mechanical Aspects of Tubingless Completions, by M. E. True and C. B. Corley, Jr.
59—PET-43 A Progress Report on the Pipeline Spheroid, by M. L. Barrett, Jr.
59—PET-44 Reciprocating Wire Line Packer Setting Tool, by Frank Sharp and A. E. Cummins
59—PET-45 Hydraulic Fracture Design, by D. D. Hunt and H. R. Crawford
59—PET-46 Application of Electronic Computers to Pipeline Operations Planning, by L. W. Ewing, Jr.
59—PET-47 Use of Rigid Polystyrene Insulation for Low-Temperature Distillation Columns, by E. E. Kimmel
59—PET-48 Controlling Electric-Centrifugal Pump Stations with Variable Speed Driver, by E. C. Michels

A dramatic moment. H. H. Meredith, Jr., past-chairman, Petroleum Division Executive Committee, presents Certificate of Merit to the widow of the late William Harrison Cline, Jr.

1959 National Power Conference Sponsored by

J. H. Foote, AIEE President, pauses with ASME President G. B. Warren to give a considered guess as to what may be ahead in power production

Preprints for sale

J. H. Harlow, chief ME, Philadelphia Electric Co.

B. S. Jeffrey, Kansas Power and Light Co. president, as banquet toastmaster

In Russia this summer . . . said H. E. Baumgardner, assistant to the president, The Detroit Edison Co.

The technical and management problems of power-plant operation and design from fuels to testing and from turbine-shell cracking to loud-speaker communications were considered in the six technical sessions of the National Power Conference held in Kansas City, Mo., September 27-30, 1959. In a turn about on the customary procedure, the addresses were presented at the luncheons, and the Banquet was the occasion for some relaxation with a humorous address by Joseph Adelman, posing as Charles L. Schaeffer of the technical staff at Los Alamos, N. Mex.

More than 400 registered for the three-day conference which was sponsored by the Power Divisions of The American Society of Mechanical Engineers and the American Institute of Electrical Engineers in co-operation with the Kansas City sections of both organizations.

President Warren Luncheon Speaker

Speaking in a dual role as ASME President and as an engineer with 40 years' experience in the power field, Glenn B. Warren, Fellow ASME, and vice-president and consultant, Turbine Division, General Electric Company, examined "What May Be Ahead in Power Production," at the opening luncheon.

Aware of the fact that "this business of looking ahead is a dangerous and uncertain one," he stated that: "If enough informed people do it independently, the consensus of such a look ahead may not be too unreliable."

He spoke of the ever-increasing importance of power production and its significance in raising the standard of living in underdeveloped nations, although power alone is not the only need. He stated that Philip Sporn had pointed out to those who thought that low-cost power was all that was needed to do the job, "that an industrial nation needs six to eight dollars invested in industrial-power-using capital-goods machinery for every dollar invested in power-producing machinery to get in position to use the power efficiently for its productive purposes."

However, the sheer magnitude of the future power development in this country and the parallel development, starting where the U. S. was ten to 50 years ago, which is just getting under way in the vast majority of the rest of the world, he concluded, offers much to think about. "To serve a population more than 12 to 15 times our own population, means that the carrying out of this great future power development here and throughout the world on an efficient and proper basis remains one of the greatest challenges that faces engineering and management today."

The technical portion of President Warren's address indicating the types of equipment, the fuels, the sizes and speeds of turbine-generators that are likely to be used in the future will appear in a forthcoming issue of MECHANICAL ENGINEERING.

Harvey E. Bumgardner, Mem. ASME, assistant to the president of the Detroit Edison Company, gave "A Special Report on the Recent Tour of the USSR—Summer, 1959," at the second luncheon.

AIEE President J. Harold Foote spoke on the "Co-Ordinating Function of the Engineer" at the final luncheon.

Technical Sessions

Technical sessions were under the auspices of the ASME Power Test Codes Committee, the ASME Research Committee on High-Temperature Steam Generation, and the ASME Fuels Division as well as the Power Divisions of both societies.

Peak-load economics and special steam-power plants designed to meet the peaking problem, a mine-mouth plant for lower fuel cost, power test codes and simplified performance tests, and some of the metallurgical problems connected with power generation were considered in the technical papers presented.

Mine-Mouth Power Plant. The Montrose Steam-Electric Station of the Kansas City Power & Light Company is the plant located near the source of fuel rather than the electric-consuming areas. It is located almost at the edge of an open-pit mine near the town of Montrose, Mo., about 60 miles southeast of Kansas City. The site was chosen to take advantage of a 45-million-ton coal reserve which could furnish enough raw coal to last the life of the power plant. Although transmission costs were increased, the total costs for power delivered to Kansas City were estimated to be about $1 million per year less for the Montrose development than they would have been for developing a new site in the Kansas City area, and $500,000 a year less than for extending an existing station in the Kansas City area. Two coal seams are worked, and the coals are blended to minimize the high sulfur content of one formation and bring the mixture within the six per cent sulfur limitations. Coal is trucked from the

ASME-AIEE Attracts Large Audience in Kansas City

pit to a 35-car, 2-man-operated, $6^{3}/_{4}$-mile-long railroad run by the Peabody Coal Company which delivers 2016 tons per day to the power station.

The plant itself is of "conventional" design including no untried features. It uses a 1450-acre-ft creek-fed pond for cooling, and is initially designed for two 1800-psig 1000-F outdoor turbines, each with a net capacity of 175 mw. The station will be developed to an ultimate net capability of 525 mw by 1963 or 1964.

Peaking. Diesel-electric generating units totaling 6000-kw capacity and simple-cycle gas turbines on the order of 20,000 kw have recently been introduced to supply peak-power demands economically. The growth of the air-conditioning load has created a summer peak as much as 50 per cent above the winter peak in the southern part of the country and varying toward equal peaks in the northern latitudes. The capital cost which must be carried during idle periods, rather than the thermal efficiency, is the key to economical peaking capacity.

Stripping the steam turbine of most of the refinements needed for high-load-factor operation and a return to lower steam conditions are advocated as a solution to low capital cost in units up to 100 or 200 mw designed solely for peak requirements. All accessories or refinements unnecessary for power generation without a sacrifice of reliability would be stripped off. Since peaking units are available most of the year for maintenance, they would not have to meet the rigid requirements of units intended for long periods of continuous service without inspection. It is believed that a reduction on the order of \$20 per kw of capacity would be possible where such units represented an extension of existing plants.

Power Test Codes. The current revision of ASME Power Test Code No. 6—Steam Turbines, initiated in 1956, was the topic of a group of papers on the revision procedure and the related topics of simplified performance tests, and "bench-mark" testing.

Although the code provides "standard directions and rules for the conduct and report of commercial routine and acceptance tests," the procedure which is designed primarily for best accuracy, is not practical from an economic standpoint—the cost may be from \$50,000 to \$75,000—as a routine test.

Simplified company-developed performance tests have been used by Philadelphia Electric Company for following plant efficiency for over 15 years. Du Pont uses tests for the acceptance of industrial-power equipment and for future design which follow the ASME Power Test Codes as closely as possible within the limitations of cost and field conditions. These provide "bench marks" for plant operators in routine daily checks of individual pieces of equipment and standards for over-all power-plant-performance efficiency checks. Computer control is also entering the picture.

A simplified test procedure, based on a modification of the Code test, is planned as a separate part of the Code revision, possibly an appendix, that will be practical for routine turbine tests from an economic standpoint. Relative accuracy will be of primary importance. The absolute accuracy will definitely be a compromise in relation to the accurate Code test.

Superheaters. A report was given on the ASME Research Committee on High Temperature Steam Generation's program to determine the performance characteristics of selected ferritic and austenitic tube materials when exposed to the action of steam at high temperatures and under pressure. The paper dealt with metallurgical evaluation of superheater-tube alloys after 6-months exposure at 1100 to 1500 F, and was the third report since the program has been established.

A review of the principal factors involved in superheater design was given to show how material considerations are the governing factors in establishing the maximum temperatures that can be used economically for generating power.

Steam-Turbine Shell Cracking. The heavier metal sections of turbines for higher steam conditions have made them more susceptible to cracking, and procedures and devices to minimize this have become imperative. Careful investigations of the material in typical cases of shell cracking reveal that, in general, the cracks are due to a form of high-temperature-rupture failure from the accumulation of creep strain over one or more starting and loading cycles. Gradual and uniform heating or cooling during the rolling period would be of major benefit in minimizing the temperature differences as great as 410 F which may exist, for example, between the inner surfaces of valve bowls with resulting plastic strain.

In designing new equipment, the use of relatively thin walls in the inlet-passage shell components to prevent large thermal differences across the walls and also to allow deflection can be beneficial. Avoidance of rapid transitions in wall thickness or contour is also among the beneficial design considerations. Operational procedures and starting methods can also contribute to a reduction in cracking.

An availability list of papers presented at this meeting follows. Digest of all papers which are not scheduled for publication in MECHANICAL ENGINEERING will appear in the "ASME Technical Digest" in this or a forthcoming issue of MECHANICAL ENGINEERING.

Plant Tours

The Montrose Steam Generating Station of the Kansas City Power & Light Company was visited, and a tour was taken of the Platte Pipeline Company's microwave control station in the KCP&L Building.

Availability List—ASME-AIEE National Power Conference

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59—PWR-1 Metallurgical Evaluation of Superheater-Tube Alloys After Six Months' Exposure at Temperatures of 1100 to 1500 F, by C. L. Clark, J. J. B. Rutherford, A. B. Wilder, and M. A. Cordovi

59—PWR-2 Montrose Steam-Electric Station Operating Experience, by G. A. Myers

59—PWR-3 The Power Mine and Coal for Montrose Station, by J. R. Jones

59—PWR-4 "Bench-Mark" Testing in Industrial Plants, by L. J. Brown

59—PWR-5 Fifteen Years' Experience Employing Simplified Performance Tests to Follow Plant Efficiency, by F. H. Light

59—PWR-6 Peaking—A Definition of the Problem, by R. W. Dodson

59—PWR-7 Development of a Power Test Code for Steam Turbines Including a New Procedure for Simplified Performance Tests, by O. D. Whiddon

59—PWR-8 Steam-Power Plants for Peaking Service, by A. R. Lebailly

59—PWR-9 Economics and Design of the Montrose Steam Electric Station, by F. A. Ritchings and W. E. Slemmer

59—PWR-10 Operation of Steam Turbines to Minimize Shell Cracking, S. B. Coulter and R. L. Jackson

59—PWR-11 Material Considerations in Superheater Design, by P. M. Brister and G. N. Emmanuel

59—PWR-12 High-Temperature Alloy Consideration in Steam-Turbine Design, by N. L. Mochel

ASME Elects Twelve to Grade of Fellow Member

The American Society of Mechanical Engineers has honored 12 of its members by electing them to the grade of Fellow of the Society.

To be qualified as a nominee to the grade of Fellow, one must be an engineer with acknowledged engineering attainment, have 25 years of active practice in the profession of engineering or teaching of engineering in a school of accepted standing, and be a Member of the Society for 13 years. Promotion to the grade of Fellow is made only on nomination by five Fellows or Members of the Society to the Council, to be approved by Council.

The men who were so honored for their outstanding contributions to their profession and to the Society are:

Frank O. Hoagland

Frank Oscar Hoagland, master mechanic, Pratt & Whitney Company, Inc., West Hartford, Conn., in his 50-year career, has been a tribute to the engineering profession. The greater part of that career has been devoted to the art and science of interchangeable manufacture through adoption of voluntary standards. His deep understanding of the role of standards in American mass production made him an early advocate of standard practices in the machine-tool and allied industries. His work has been patient, painstaking, and effective in the development of those standards. He has made brilliant contributions to the technical work of many ASA-ASME committees; and has written and lectured widely on the practical application of mechanical standards. For several years prior to and during World War I, he was chief engineer of the Remington Arms plants at Illion, N. Y., and Bridgeport, Conn. He has been with Pratt & Whitney Division for over 45 years. During World War II, he contributed much to technical advancements in the manufacture of gun barrels and served as technical expert for the War Production Board. As author of more than 60 papers, lecturer and teacher throughout the country, and inventor holding over 80 patents, he has won numerous honors. Early in his career, he received the Gold Medal at the 1915 Panama-Pacific International Exposition for the development of arms and ammunitions while with Remington. The American Standards Association, which he helped to establish, awarded its Standards Medal to him in 1952. ASME honored him twice: once with the 75th Anniversary Medal and, again, with the ASME Award in 1958. Mr. Hoagland has served the Society since 1912, having been chairman of a number of national and local committees and, in 1938, a vice-president of ASME. He is a member also of the National Machine Tool Builders Association. He is a registered professional engineer in the State of Connecticut.

Rollin H. McCarthy

Rollin Herbert McCarthy is director of plant engineering, Western Electric Company, Inc., New York, N. Y. In the first 27 years with the company, his work called for taking complex designs from the laboratory and putting them into practical, large-scale, low-cost production. This required the development of processes and machinery and the organization of new shops introducing products ranging from telephone booths to cables, vacuum tubes, switchboards, and electronic amplifiers. His most recent work of this kind was the manufacturing engineering for and supervision of the production of repeaters for the first transatlantic telephone cable, from 1952 to 1955. This involved the organization of the personnel, processes, and equipment and materials for the construction under laboratory conditions of a product designed to operate continuously without maintenance or repair for 20 years.

Since 1955 he has been in charge of plant design and construction for a portion of the Company's program of construction of factories, distributing houses, laboratories, and office buildings. Prior to his association with Western Electric, Mr. McCarthy had taught at the University of Nevada and Cornell University. During World War I, he served in the U. S. Army Signal Corps. He is the author of a number of papers on a variety of subjects published in Mechanical Engineering and other professional journals.

Mr. McCarthy has served the Society on both the national and local level. He has been chairman of the Production Engineering and the Wood Industries Divisions; and has been a General Committee member of the ASME Organization Committee and the Professional Divisions Committee. He is a registered professional engineer in the State of New York.

Max B. Robinson

Max Brewster Robinson, dean of co-operative education, Fenn College, Cleveland, Ohio, is a national authority in his field. His career encompasses every aspect of co-operative education. While studying at the University of Cincinnati, he was a co-operarive trainee at the Cincinnati Planer Company. He has since been a counselor, educator, educational administrator, and co-operative employer. Before joining the faculty at Fenn in 1933, he had been an instructor at the University of Cincinnati; professor of mechanical engineering, University of Akron; director of engineering and co-ordinator, Evansville College; and director of training and employment, Cincinnati Milling Machine Company. Throughout his career he has extended the influence and improved the effectiveness of co-operative education. His published works on the subject have appeared in industrial as well as educational publications. He has served ASME in an active capacity in the Cleveland Section, having been a member of its Executive Committee, its Nominating Committee, and a member of a number of other working committees. He has been equally active in the Cleveland Engineering Society, and served six years on the board of governors, two years as treasurer, and one year as a vice-president. In the ASEE he served two years as member of council, twice served as national chairman, and once as vice-chairman of the Co-Operative Engineering Education Division. He represents the Occupational Planning Committee of the Welfare Federation on the Advisory Board of the Ohio Unemployment Compensation Office. Dean Robinson has been a registered professional engineer in the State of Ohio. He retired on September 1, 1959.

Sumner B. Ely

Sumner Boyer Ely is now retired after a long career as an engineer and executive in the steel industry, as a professor of commercial, power, and mechanical engineering, and as a civil servant working for smoke abatement in the Pittsburgh Pa., area. It was in this last calling, assumed after the conventional retiring age, that Professor Ely has achieved eminence. Because of age limitations, he became professor emeritus at Carnegie Institute of Technology in 1940. At that time he took a "temporary" position, which became permanent, as superintendent of the Pittsburgh Bureau of Smoke Prevention. He retired from that post in 1957 after having transformed the City of Pittsburgh from the "Smoky City" to the "Steel City." His work made the Bureau a model for other cities, and his advice was sought by others working on the same problem both here and abroad. The Pittsburgh City Ordinance prepared for the Bureau of Smoke Prevention has been used as a pattern for similar regulations in cities throughout the United States. For 20 years prior to 1940, Professor Ely had been on the faculty of mechanical engineering at Carnegie Institute of Technology. While there, in addition to his regular teaching duties, he assumed responsibilities, in 1926 and 1928, as secretary of the first and second International Conference on Bituminous Coal; in 1930 he was vice-chairman of the third such conference. In 1936, Professor Ely was supervisor of sessions for the Third World Power Conference in Washington, D. C. As an engineer in industry he distinguished himself in executive posts with several steel companies. Professor Ely has written numerous papers published in MECHANICAL ENGINEERING, *The Scientific Monthly*, and *Electric World*. He is the author of a book, "The Theory of Engine Balancing," privately printed for use of students at Carnegie Tech. He has served ASME as a chairman of the Committee on Local Sections and as a member of the Fuels Division Executive Committee. He is a member also of SAE, AAAS, AAUP, SPEE, and was president of the Smoke Prevention Association of America in 1947 and re-elected in 1948. In 1956 he was named an honorary member of the Air Pollution Control Association. In 1955 he was named an honorary member of the National Association of Power Engineers. He is a past-chairman of the ASME Pittsburgh Mechanical Section as well as past-chairman of the Mechanical Section of the Engineer's Society of Western Pennsylvania. He is a registered professional engineer in the Commonwealth of Pennsylvania.

Arthur M. G. Moody

ARTHUR MAURICE GREENE MOODY is chief engineer, product development, The Trane Company, La Crosse, Wis. His work in the field of turbomachinery has been done with DeLaval Steam Turbine Company and the Elliott Company as well as with Trane. Mr. Moody was associated with some early developments of turbosuperchargers and gas turbines. He conducted studies in the cooling of gas-turbine rotors and the application of gas turbines to aircraft. At the Elliott Company, Mr. Moody focused his work on centrifugal compressors. There, he directed the development of commercial lines of single and multistage centrifugal compressors and expanders. The first line of hermetic centrifugal refrigeration machines, from 50 hp to 1400 hp, was his development. This line has been an outstanding commercial success for the Trane Company and has influenced the whole field of centrifugal refrigeration. Mr. Moody's published works have appeared in the journals of the ASME and in the technical press. He holds five patents. His services to the Society were recognized when he was awarded the ASME 75th Anniversary Medal. He has been chairman of the Trenton, N. J., and Westmoreland, Pa, Subsections; and the Pittsburgh, Pa., Section. He has also been instrumental in the organization of the La Crosse, Wis., Section. He has been a member and chairman of a number of Power Test Code Committees; and he has worked with the Hydraulic, Gas Turbine Power, and Process Industries Divisions, having served as chairman of the last. He is a member of the Standing Committee on Power Test Codes. He is a member also of SAE, ASEE, and NSPE. Early in his career, Mr. Moody had been an instructor at the University of Delaware; later he lectured on heat and power at Princeton University. He is a registered professional engineer in the States of Wisconsin and New Jersey.

Alexander I. Ponomareff

ALEXANDER I. PONOMAREFF, member of the vice-president's staff, Steam Division, Westinghouse Electric Corporation, Lester, Pa., is an internationally recognized leader in the field of aerodynamics as well as hydraulics. Except for a three-year period, from 1930 to 1932 when first he was a design engineer with W. W. Jourdin & Company, Inc., of New York City, and later when he was assistant professor of mechanical engineering at the University of California at Berkeley, the remarkable record of achievement which highlights his professional career is identified with Westinghouse. Directly after he was graduated from the University of Utah, in 1926, he was accepted as an engineering trainee and, in 1928, attended the Westinghouse Advanced Design School. He returned to Westinghouse in 1932 as a section manager. He rose through the ranks until, in 1957, he was made a member of the vice-president's staff. His contributions have been of major importance. Personally, he was responsible for the commercial development of propeller-type circulating water pumps. He has pioneered the commercial use of model testing with air to determine the performance of hydraulic components. He holds ten patents which attest to the wide range of his efforts. His work on forced draft blowers of axial-flow type has been responsible, to a great extent, for the present high level of efficiency and reliability of these units. Through his ingenuity and courage in the design, the extremely large compressors for the propulsion wind tunnel for the Arnold Engineering Development Center at Tullahoma, Tenn., were constructed. These units are still among the largest items of rotating machinery in the world. Mr. Ponomareff assisted with the design of the first American-designed axial-flow compressor for turbojet engines and was responsible for the design of a large number of axial-flow compressors including one for the first locomotive gas turbine. The Bureau of Ships, Department of the Navy, at the end of World War II, cited him for his significant contributions to the design of forced draft blowers for shipboard applications and for his general co-operation in the war effort. In 1958 Mr. Ponomareff received the Order of Merit from Westinghouse for his leadership and original work in developing and advancing the design of blowers and compressors for Navy and commercial applications. He has served the Society as chairman of the Power Test Code Committee No. 14 on Evaporating Apparatus; and has been a member of several research subcommittees. He also is a member of ASNE, The Franklin Institute, Tau Beta Pi, and Phi Kappa Phi. He is a registered professional engineer in the Commonwealth of Pennsylvania.

H. W. Robb

HARRY W. ROBB has been employed by General Electric since graduation from Cornell University in 1923. There he has been engaged principally in engineering staff activities in development and organization of technical data, identification systems, and Company standards on materials, parts, finishes, test methods, and various engineering practices. Until December, 1958, he was manager-Company Standards in Engineering Standards Service and is now a consultant in the Engineering Administrative Consulting Service. Outside of the Company, Mr. Robb has been active in various administrative and technical committees of the Society, Nema, and ASA. He was a member of the ASME Standardization Committee from 1949 to 1953 and chairman in 1953. He is completing a five-year term as a member of the ASME Codes and Standards Committee. In 1957 he was appointed one of the Society's representatives on the ASA Standards Council. He is also a Nema representative on the ASA Graphic Standards Board and Mechanical Standards Board, being vice-chairman and member of the Executive Committee of the latter. He was chairman of the ASA Company-Member Conference in 1947 and 1948 and has served on no less than 14 ASA sectional committees and numerous subcommittees on screw threads, pipe threads, limits and fits, machine pins, knurling, gears, keys, washers, metal gages, surface roughness, graphical symbols, colors, and bolts and nuts, being chairman since 1947 of Sectional Committee Z55 on Colors for Apparatus and B18 on Bolts, Screws, Nuts, and Rivets. He is an industry representative on the Government's Interdepartmental Screw Thread Committee and in 1951 served on the NPA Production Controls Staff of the U.S. Department of Commerce as Director of Engineering Materials and Methods. In American-British-Canadian standardization he has taken an active part in conferences on screw threads, bolts and nuts, and limits and fits, being chairman of the 1950 Conference and also the American delegation to London in 1951 on bolts and nuts and of the 1952 and 1953 Conferences on limits and fits. Mr. Robb has published several articles on the standards and related subjects. He is also a member of AIEE, American Ordnance Association, and Professional Engineers Society and has been awarded several certificates of service by the Society, ASA, and Government.

H. S. Van Patter

HUGH STANLEY VAN PATTER, vice-president and director, Dominion Engineering Works, Ltd., Montreal, Que., Canada, is recognized for his work in the field of hydroelectric plant machinery and engineering management. Mr. Van Patter, after serving with the Canadian Forces in World War I, entered the employ of Dominion Engineering Works in May, 1920. He advanced from junior engineer through positions of hydraulic engineer, chief hydraulic engineer, chief engineer and manager of the Hydraulic Division, to vice-president and director. In the period 1920 to 1958, the firm has been designer and producer of 413 turbine units with a total rating of over 13 million hp. Mr. Van Patter has been responsible for construction of experimental hydraulic laboratories for turbines, pumps, and cavitation, the latter capable of testing models up to 16 in. in diam and under substantial heads. Among his more recent projects are the 16 Francis-type units of 105,000 hp for Sir Adam Beck-Niagara Falls Plant of the Hydro-Electric Power Commission of Ontario. Mr. Van Patter's contributions to the profession have been recognized by Queens University which presented him with an honorary LLD degree. He has been active in ASME affairs, having served as Secretary and Chairman of the Executive Committee, Hydraulic Division, and as a member of PTC No. 18, Hydraulic Prime Movers Committee. He is a Life Member of EIC and has served on the ASME-EIC Joint Council. He is Canadian Chairman of Technical Committee No. 4 on Hydraulic Turbines of the International Electrotechnical Commission.

C. C. Wilcox

CARL CLIFFORD WILCOX, consulting engineer, South Bend, Ind., has made contributions to the engineering profession both as a teacher and as an engineer in industry. He has been most concerned with design of utility-generation and distribution facilities. As head of the department of mechanical engineering, at the University of Notre Dame, 1937–1950, he was largely responsible for the improved and modernized curriculum which led to the department's accreditation by ECPD. Also at Notre Dame, he designed and was instrumental in the building of the Heat Power Laboratory. From 1942–1944, on leave from his teaching post, he was chief engineer with J. Gordon Turnbull-Sverdrup & Parcel, prime architect-engineer contractors for the U. S. Government on the Canol Project. The $150-million project had as its aim the development of oil resources in Alaska and the Canadian Northwest. Mr. Wilcox supervised survey and design of 1578 miles of pipeline and 29 oil-pumping stations with access roads, housing, maintenance, and the like—all in subarctic territory never before mapped. From 1922–1937, Professor Wilcox had been superintendent of power for Studebaker Corporation. He holds a patent, assigned to Studebaker, for an automatic saturating device by which steam in the heating coils of a body oven could be automatically vented to the oven. He is the author of several papers on the subject of power-plant engineering. He served the Society as chairman of the St. Joseph Valley Section, 1932–1934.

G. F. Wislicenus

GEORGE FRIEDRICH WISLICENUS is director of the Garfield Thomas Water Tunnel and professor of aeronautical engineering at the Pennsylvania State University, University Park, Pa. He is an acknowledged authority in the field of fluid mechanics and design of turbomachines. He has supplied practical analytical methods for treating separation, three-dimensional flow, and cavitation in turbomachinery. He pioneered the application of supersonic relative velocities in axial-flow compressors, demonstrating the nonexistence of the "starting problem." In machine design, he made significant contributions to the art of designing large high-head, high-efficiency centrifugal pumps, high-pressure multistage boiler feed pumps, and turbofan aircraft engines. He holds nine patents. Before joining the faculty at Penn State, Professor Wislicenus was professor and chairman of the department of mechanical engineering at The Johns Hopkins University. In industry, he has been assistant chief engineer of design and research, Aircraft Engine Division, Packard Motor Car Company, Toledo, Ohio. Earlier, 1935–1948, Dr. Wislicenus had been with the Worthington Pump and Machinery Corporation. He has also been consultant to: The National Advisory Committee for Aeronautics (now NASA), the National Research Council, the Department of the Navy (Office of Navel Research, Bureau of Ships, Bureau of Ordnance), U. S. Atomic Energy Commission, and others. He is the author of numerous papers published in the *Transactions of the ASME*. His text, "Fluid Mechanics of Turbomachinery," McGraw-Hill Book Company, Inc., 1947, is recognized as authoritative. Dr. Wislicenus is a member also of ARS, IAS, Sigma Xi and Pi Tau Sigma, and recipient of the Manly Memorial Medal of the SAE.

Leland D. Cobb

LELAND DAVISON COBB is manager of research and development, New Departure Division, General Motors Corporation, Bristol, Conn. More than 30 patents taken out by him and assigned to New Departure attest to his achievements in the field of bearing application and design. These patents include the first integral sealed ball or roller bearing, the basic idea of which is used on approximately 30 per cent of all bearings produced today. His patents also include: First patent issued on removable seals, seal improvements, separator designs allowing high-speed (over 100,000 rpm) of ball bearings, antifriction bearings for loom treadle rolls which reduced the fire hazard in textile mills, and many others. He has 25 patents pending. Mr. Cobb has been with New Departure since 1928 with the exception of a brief period as assistant to the chief engineer at the Draper Corporation. He returned to the division in 1943 as executive engineer, became assistant to the general manager in 1945, and in 1947 assumed his current post. He has direct control over all research and development relating to New Departure products. The previously mentioned separator design for high-speed ball bearings was developed during this period, and is now widely used for aircraft-accessory units and missile guidance systems. Mr. Cobb has been responsible for design and building of a full-scale test rig for engine bearings which measures bearing-component temperature, speed, air flow, lubrication weighting, bearing torque, and such. The rig has no parallel in the industry. Mr. Cobb has presented a number of papers before the ASLE and SAE. He is a member also of SAE and the Society for Non-Destructive Inspection. He has served his community as a member of the City of Bristol Chamber of Commerce since 1948, and has held several offices in the Asbury Methodist Church, Forestville, Conn.

Carl Wischmeyer

Carl Wischmeyer, before his retirement in 1955, was head of the department of mechanical engineering and vice-president of Rose Polytechnic Institute, Terre Haute, Ind. In his 47 years on the faculty at Rose, he has advanced through all academic ranks. He was made head of the department of mechanical engineering in 1925. In 1937 he was made vice-president of the institute, and he served as acting president in 1948–1949. During World War I, he was vocational director for the Student Army Training Corps at Rose. In the second world war, he served as institutional representative for engineering science and management war training. In recent years, he has also acted as a consultant for the Columbian Enameling and Stamping Company, and has done considerable work in the field of steam power plants. He is the author of a book, "Descriptive Geometry." In recognition of his many years of devoted service to the institute and of his engineering achievements, Rose Polytechnic conferred an honorary DE degree upon him in 1955. He is a member also of the American Association of University Professors, ASEE, AAAS, and Tau Beta Pi. He is a registered professional engineer in the State of Indiana.

MEETINGS OF OTHER SOCIETIES

November 11–13

Operations Research Society of America, national meeting, Huntington-Sheraton Hotel, Pasadena, Calif.

November 12–13

American Society of Industrial Designers, Statler Hilton Hotel, New York, N. Y.

November 16–19

Building Research Institute of the National Academy of Sciences-National Research Council, fall meeting, Shoreham Hotel, Washington, D. C.

November 19

Society of Plastics Engineers, plastics in packaging, San Francisco, Calif.

November 30–December 3

Eastern Joint Computer Conference, Statler Hilton Hotel, Boston, Mass.

November 30–December 4

27th Exposition of Chemical Industries, New York Coliseum, New York, N. Y.

December 2–4

AIME, electric furnace steel conference, Hotel Cleveland, Cleveland, Ohio.

December 9–11

Société des Ingenieurs Civils de France, conference on machine noises, Paris, France.

December 13–16

The Material Handling Institute, Inc., annual meeting, Savoy-Hilton Hotel, New York, N. Y.

(*ASME Coming Events, see page 116*)

Nominations Open for 1961 ASME Officers

Section Advisers to Regional Nominating Committee Members Provide Channel for Suggestions Requested From Each Member

At the first meeting of the 1960 National Nominating Committee in St. Louis, Mo., last June, much emphasis was laid on the democratic process by which officers of the ASME are chosen. The Committee is thoroughly imbued with the essential principle that must govern all their deliberations—the office must seek the man, and not the inverse.

The Nominating Committee therefore cannot discharge its duties properly without your help—yes, you the ordinary member from Walla Walla, Waco, Wichita, Waycross, or Waterbury. It is you in each of the 92 sections of our great Society who know the men in your section—your friends—who have been "carrying the ball" for ASME. These are the men who should be the future Regional and National officers of our Society. The National Nominating Committee may never know of these dedicated workers unless you act in their behalf—certainly they will not actively seek office themselves.

A direct line of communication has been established for your use. Each section has been asked to appoint an adviser on nominations. Your duly elected regional member, who together with the seven other regions' representatives (and the three selected by committee conference) make up the National Nominating Committee, will serve as the chairman of this group of advisers in your region. If you know men in your section who have the acknowledged qualities of outstanding ability and leadership in their profession, please suggest them to your section adviser on nominations or, better yet, act as sponsor for such men. Your nomination sponsorship must be on a form which you can secure from headquarters in New York or from your regional nominating committee member. The names and addresses of all the nominating committee members and their alternates were published in the August, 1959, issue of Mechanical Engineering, pp. 127.

Those of you who are active in the Professional Divisions as well as those in section activities should be particularly able to give sound recommendations to your section adviser on nominations. While the Boards, Committees, and Professional Divisions make recommendations through nominating conferences provided for in the Constitution and By-Laws of the Society, your suggestions to them can also be invaluable. Accordingly, you may make your nomination through your group's representative or directly to John W. McKiernan, Secretary, 1960 Nominating Committee, ASME, Sandia Base, Albuquerque, N Mex.

Offices to be Filled for 1961

President..........To serve 1 Year

Vice-President,
  Region II.......To serve 2 Years

Vice-President,
  Region IV.......To serve 2 Years

Vice-President,
  Region VI.......To serve 2 Years

Vice-President,
  Region VIII.....To serve 2 Years

Two Directors
  (at large).......Each to serve 4 Years

It is your obligation, privilege, and responsibility as well as that of every other member of the Society to assist the National Nominating Committee in obtaining the best men available for officers of The American Society of Mechanical Engineers.

Conducted
for the
National Junior
Committee

A. S. GOLDSTEIN[1]

JUNIOR FORUM

The Role of the Mechanical Engineer in the Electron-Tube Field

By Gerald W. Karlsruher[2]

Gerald W. Karlsruher

ELECTRON tubes impress most of us as being in the domain of the electronic engineer. This assumption, however, is not entirely true because about perhaps 80 per cent of all tube work falls into the mechanical-engineering category.

The first electron tubes heralded the electronic age. These were the receiving tubes with which we are all familiar from our experiences with radio and television sets. The functions of these small tubes are rectification, amplification, oscillation, frequency conversion, modulation, and detection of signals—just to name a few. The British use the expression "electric valve" for certain types of tubes which adequately describe their action in an electronic circuit.

The tube field is by no means restricted to such small structures. We are all familiar with cathode ray tubes (TV picture tubes), and there are a great variety of power tubes which can be found in places such as radio broadcasting stations, diathermy equipment, radar stations, and so on.

World War II, and the period following, brought on a new array of tubes whose function is to generate radio waves at extremely high frequencies. Most of these tubes are magnetrons, klystrons, or traveling wave tubes. Some of these are used in high-power applications, while others are used for generating signals of the order of milliwatts for communications systems and for measurement purposes.

The following brief discussion is intended to describe some problems of considerable interest to mechanical engineers.

Mechanical Design. Electron tubes are generally operated at elevated temperatures and must give specified performance for many hours, often under adverse environmental conditions such as shock, vibration, and humidity. Optimum mechanical design is, therefore, of paramount importance, and almost every new tube that is developed involves problems in structural analysis.

The mechanical design of these structures must take into account materials of low vapor pressure which operate in vacuum, materials which keep their strength at elevated temperatures, and whose metallurgy allow them to be brazed and welded to similar or dissimilar metals. The engineer must, therefore, not only have knowledge of the physical properties of these metals, but must also take account their continued behavior during the life of the tube.

The problem of heat transfer is a serious one, particularly since most tubes generate a great amount of heat in a limited cooling area. Should a certain part within the tube run too hot, serious difficulties and malfunctions may occur such as the deposition of leakage paths, loss of electron emission, or degradation of the vacuum.

The mechanical design is not restricted to that of the tube itself. Much engineering effort goes into the design of automatic and semiautomatic machinery required to make the special parts for tubes, as well as to seal tubes vacuum tight to the envelope, and to process the parts and final assembly. These machines may wind tungsten wire of extremely small diameter on to much larger wire or stampings, thereby forming the grid. These are but a few of the many examples that could be cited of machine-design problems to which many mechanical engineers are assigned. Despite the trend toward automation, hand assembly is still required in most tube-manufacturing operations. Therefore many challenging and stimulating problems exist for the design of automatic tube assembly machines suitable for assembling the many varied types of receiving tubes.

Today's military and other specialized requirements are such that a tube must be able to withstand severe environmental conditions, as well as many other stringent tests, before a tube can be accepted. It is, therefore, an engineering function to take into account means of adequately cooling the structure, damping vibrations, providing a design having maximum resistance to mechanical shock, and, in general, making a compactly packaged unit with minimum weight and volume.

Assembly Techniques. To the layman looking into a glass tube to view the structure, the first impression is likely to be that no great problems exist—certainly not when comparing a tube with a gyroscope, or possibly an accelerometer. However, this is hardly the case. A tube generally consists of intricate, closely toleranced parts made from special alloys and refractory metals such as tungsten, molybdenum, titanium, or tantalum, all of which must be heated to very high temperatures in vacuum or hydrogen to remove all possible occluded gases. These are then placed together in subassemblies using resistance or other welding processes, as well as high-temperature metal-brazing processes.

The problems in assembly techniques are, therefore, largely problems in the wisest use of design principles and means for controlling dimensions. It takes ingenuity and, most important, a thorough grounding in physics, metallurgy, chemistry, and general engineering principles.

Processing. There is an important place for the mechanical engineer in what is generally called tube finishing or processing. Here the tube is exhausted and its parts are thoroughly outgased by rf heating or electron bombardment. In order that these operations may successfully be performed, proper mechanical design of equipment and of the tube structure itself are absolute essentials.

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[1] Engineering writer, General Electric Advanced Electronics Center at Cornell University, Ithaca, N. Y. Assoc. Mem. ASME.

[2] Supervisor, Engineering Services, Sylvania Research Laboratories, Bayside, N. Y. Assoc. Mem. ASME

The mechanical engineer can and has made highly important contributions to this very exciting engineering field. He deals with problems and variables that often defy classification and are seemingly unsolvable. Therefore he never runs out of opportunities to learn more so that a product can be made at lower cost yet have marked improvements in performance and reliability.

ASME Elects New Officers by Letter Ballot

As REPORTED by the tellers of election of 1960 officers, Robert E. Abbott, Frederick H. Linley, Jr., and John Weiss, letter ballots received from members of The American Society of Mechanical Engineers were counted on Sept. 22, 1959.

The total number of ballots cast was 11,874, of these 148 were thrown out as defective.

	Votes for	Votes Against
For President		
Walker L. Cisler	11,693	33
For Regional Vice-President —serve two years		
Charles H. Coogan, Jr.	11,696	30
Donald E. Marlowe	11,703	23
Henry N. Muller, Jr.	11,705	21
William C. Heath	11,712	14
For Directors —serve four years		
Everett M. Barber	11,711	15
William H. Larkin	11,708	18
Clarence C. Franck, Sr.	11,715	11

The new officers will be introduced and installed in office during the 1959 Annual Meeting of the Society to be held at the Chalfont-Hadden Hall, Atlantic City, N. J., November 29 through December 4, 1959.

Biographical sketches of the newly elected officers were published in the August, 1959, issue of MECHANICAL ENGINEERING, pp. 130–135. ASME Annual, AC-10, published early each year contains complete lists of officers and personnel composing the Council, Boards, and Committees of the Society.

ASME CODES AND STANDARDS WORKSHOP

Interpretations of 1955 Code for Pressure Piping

FROM time to time certain actions of the Sectional Committee B31 will be published for the information of interested parties. While these do not constitute formal revision of the Code, they may be utilized in specifications, or otherwise, as representing the considered opinions of the Committee.

Pending revision of the Code for Pressure Piping, ASA B31.1–1955, the Sectional Committee has recommended that ASME, as sponsor, publish selected interpretations so that industry may take immediate advantage of corresponding proposed revisions. Case No. 42 is published herewith as an interim action of Sectional Committee B31 on the Code for Pressure Piping that will not constitute a part of the Code until formal action has been taken by the ASME and by the American Standards Association on a revision of the Code.

Case No. 42

Inquiry: What is the intent of Section 8 of the Code for Pressure Piping on the requirements for reinforcement of extruded headers?

Reply: It is the opinion of the Committee that the principles of reinforcement as stated in Paragraph 831.41 apply to contoured extruded outlets. The definition of dimensions given in this paragraph, and as illustrated in Figure 831.A, are applicable to conventional welded branch connections. Until such time as the rules are revised dimension L may be taken as $2\text{-}{}^1/_2H$, and d may be taken as the minimum bore of the outlet.

The Committee wishes to advise that this opinion is rendered as an interim measure and does not set a precedent since the Committee is awaiting the conclusion of extensive research work now in progress and intends to revise the rules for reinforcement to reflect the findings of this work.

Revised American Standard for Rotating Air Cylinders and Adapters

By C. T. Blake, Chairman B5 TC/11

A REVISED edition of this standard has just been issued to supersede ASA B5.5–1954. The method of dimensioning radial hole locations has been changed to follow the principle set forth in American Drafting Standards Manual on Dimensioning and Notes (ASA Y14.5–1957) to insure interchangeability. In addition, minor changes have been made in the tables, where possible, to permit design of lighter and shorter cylinders reflecting the modern trend toward higher rotating speeds.

Copies are available from the ASME Order Department, 29 West 39th Street, New York 18, N. Y.

Executive Committee of Sectional Committee B31 on Code for Pressure Piping attends a luncheon meeting, September 15, at the Engineers' Club, New York City. E. O. Bergman, Mem. ASME, chairman of the ASME Board on Codes and Standards, presented retiring members of the Committee with the Society's Certificate of Award for their work in standardization. Those honored include L. W. Benoit, Mem. ASME; Sabin Crocker, Fellow ASME; C. A. Kelting, Mem. ASME; V. T. Malcolm; and D. G. Reid, Assoc. Mem. ASME. Also present at the meeting are: F. S. G. Williams, Fellow ASME, chairman; J. P. Mooney, Mem. ASME, vice-chairman; R. V. Warrick, Mem. ASME, secretary; J. J. Kanter, Fellow ASME; W. P. Kliment, Mem. ASME; D. W. Motter; E. A. McPhillamy; F. W. Philippbar, Mem. ASME; E. C. Pandorf; M. B. Conviser; W. R. Gall; W. R. Steur; O. W. Heyden; A. H. Cramer; T. J. Miller; Glen Winans; K. W. Haupt, Mem. ASME; W. M. Frame; G. R. Locke; M. D. Webb; Elton Wiseman, Mem. ASME; T. C. Clarke; C. M. Vogrin, Mem. ASME; and A. G. Smith.

1959 West Coast Conference of Applied Mechanics Held in Stanford, Calif.

The Applied Mechanics Division of The American Society of Mechanical Engineers held a West Coast Conference, Sept. 9–11, 1959, supplementing its regular Annual Conference which was held, this year, in Troy, N. Y., in June. The West Coast Conference, sponsored by the Division in conjunction with the American Society of Civil Engineers, took place in the Physics Lecture Hall, Stanford University, Stanford, Calif.

A total of 23 technical papers were contributed by the ASME's Applied Mechanics Division, and presented at the Conference.

Availability List—Applied Mechanics West Coast Conference

The papers in this list are available in separate copy form until July 1, 1960. Please order only by paper number; otherwise the order will be returned. Copies of these papers may be obtained from the ASME Order Department, 29 West 39th Street, New York 18, N. Y. Papers are priced at 40 cents each to members; 80 cents to nonmembers. Payment may be made by check, U. S. postage stamps, free coupons distributed annually to members, or coupons which may be purchased from the Society. Coupons, in books of ten, are $3 to members. $6 to nonmembers.

59—APMW-1 Developments in the Application of the Grid Method to Dynamic Problems, by A. J. Durelli, J. W. Dally, and W. F. Riley

59—APMW-2 Axially Symmetric Waves in Elastic Rods, by R. D. Mindlin and H. D. McNiven

59—APMW-3 Rupture Characteristics of Safety Diaphragms, by N. A Weil

59—APMW-4 Response of a Nonlinear String to Random Loading, by T. K. Caughey

59—APMW-5 Response of Van der Pol's Oscillator to Random Excitation, by T. K. Caughey

59—APMW-6 Slow Rotary Motion of a Circular Disk About One of Its Diameters in a Viscous Fluid, by R. P. Kanwal

59—APMW-7 On the Effect of Shear on Plastic Deformation of Beams Under Transverse Impact Loading, by B. Karunes and E. T. Onat

59—APMW-8 Viscous Damping in Flexural Vibrations of Bars, by M. K. Newman

59—APMW-9 Stresses in a Circular Cylinder Having an Infinite Row of Spherical Cavities Under Tension, by Akira Atsumi

59—APMW-10 The Fundamental Frequency of a Thin, Flat, Circular Plate Simply Supported Along a Circle of Arbitrary Radius, by R. Y. Bodine

59—APMW-11 The Melting of Finite Slabs, by T. R. Goodman and J. J. Shea

59—APMW-12 The Free Vibrations of Grillages, by J. P. Ellington and H. McCallion

59—APMW-13 On Stress-Strain Relations and Strain-Energy Expressions in the Theory of Thin Elastic Shells, by J. K. Knowles and Eric Reissner

59—APMW-14 Boundary-Layer Solution for a Flow in a Diverging Passage Having a Swirl Component, by M. A. Sinbel

59—APMW-15 Transverse Flexure of a Semi-Infinite Thin Plate Containing an Infinite Row of Circular Holes, by O. Tamate

59—APMW-16 Plastic-Stress Concentration at a Circular Hole in an Infinite Sheet Subjected to Equal Biaxial Tension, by Bernard Budiansky and O. L. Mangasarian

59—APMW-17 On the Propagation of Shock Waves in a Nonhomogeneous Elastic Medium, by Eli Sternberg and J. G. Chakravorty

59—APMW-18 Effect of the Wall on Two-Phase Turbulent Motion, by S. L. Soo and C. L. Tien

59—APMW-19 Bending of Isosceles Right Triangular Plates, by H. J. Fletcher

59—APMW-20 The Solution of Elastic Stability Problems with the Electric Analog Computer, by J. H. Shields and R. H. MacNeal

59—APMW-21 Heat Transfer for Laminar Flow in Ducts with Arbitrary Time Variations in Wall Temperature, by Robert Siegel

59—APMW-22 Postbuckling Behavior of Rectangular Plates with Small Initial Curvature Loaded in Edge Compression, by Noboru Yamaki

59—APMW-23 Vibrations and Waves in Elastic Bars of Rectangular Cross Section, by R. D. Mindlin and E. A. Fox

ACTIONS ASME EXECUTIVE COMMITTEE

A meeting of the Executive Committee of the Council was held on Friday, Sept. 11, 1959, in the rooms of the Society.

There were present: G. B. Warren, *chairman;* E. W. Allardt, L. N. Rowley, R. B. Smith, and A. W. Weber of the Executive Committee; Joseph Pope, Director; E. J. Kates, treasurer; O. B. Schier, II, secretary; T. A. Marshall, Jr., senior assistant secretary; W. E. Letroadec, W. E. Reaser, and S. A. Tucker, assistant secretaries; H. I. Nagorsky, controller; and D. B. MacDougall, associate head, Field Service.

The following actions are of general interest.

Dues of Members in Foreign Countries. A policy regarding dues of members in foreign countries has been in effect since November 25, 1945, revised February 6, 1959 (P-2.6), and has received annual action since. The Executive Committee of the Council voted all dues of foreign members to be paid in United States Dollars; payments for publications of ASME publications by foreign members, other foreign engineers, and foreign engineering societies, libraries, and schools to be paid in United States Dollars; and a young foreign engineer who is in this country temporarily for training may for one year be permitted to pay the dues of a Student Member in order to have the privilege of receiving Mechanical Engineering and attending meetings during his residence in the United States.

Where currency restrictions and other problems make payment in United States Dollars impossible or difficult, the Secretary of the Society is authorized to accept payment in other currencies or arrange for the exchange of funds with recognized foreign engineering societies on a reciprocal basis. Payments should be on a basis of the rate of exchange in effect at the time the obligation becomes due for dues or publications. Funds in foreign currencies accumulated by foreign engineering societies and in foreign depositories shall be available for use in foreign countries as authorized by the Secretary. Foreign bank accounts to be established if necessary for the depositing of funds paid by foreign members, other engineers, schools, and libraries who are unable to utilize the reciprocal arrangements with foreign engineering societies. These alternations could be canceled at such time as the free exchange of currencies would permit.

Custodian Funds. Gantt Biography. The Executive Committee of the Council voted: To establish a Custodian Fund to be administered by ASME upon authorization of C. E. Davies and C. A. Jurgensen.

Hydraulic Division. The Council authorized the establishment of a Custodian Account for the ASME Hydraulic Division.

Research Funds. On recommendation of the Board of Technology at its meeting on Sept. 9, 1959, the Executive Committee of the Council authorized the transfer, subject to the approval of the Finance Committee, of $3500 from the Research Operating Reserve, Custodian Account G-53, to the General Research Fund, Custodian Account G-37, to cover current needs of the Research Executive Committee for the fiscal year 1959–1960.

Transfer of Custodian Fund for Screw Thread Survey. Upon recommendation of the Chairman of Sectional Committee B1, Screw Thread Survey, the Executive Committee of the Council voted to transfer the residue of $44 from the former Screw Thread Survey Custodian Fund to G36, General Standardization Fund.

Council Member. The Executive Committee of the Council accepted Henry S. Aurand's resignation as a member of the Council effective Oct. 15, 1959, and recommend Council approval by letter-ballot of the appointment of Vice-President-Nominee William C. Heath to serve as Vice-President Region VII from Oct. 15, 1959, to Nov. 30, 1959, to complete the unexpired term of Vice-President Henry S. Aurand.

Sections. Central Michigan Section. Upon recommendation of Vice-President Allardt, Region V, and the approval of the Central Michigan and Detroit Sections, the Executive Committee of the Council authorized the transfer of Lenawee, Branch and Hillsdale Counties in Michigan from the Detroit Section to the Central Michigan Section.

Saginaw Valley Subsection of the Detroit Section. Upon recommendation of Vice-President Allardt, Region V, and the approval of the Detroit Section and the Saginaw Valley Subsection, the Executive Committee of the Council authorized the inclusion of the following Michigan Counties in the territory of the Saginaw Valley Subsection of the Detroit Section: Gratiot, Isabella, Clare, Gladwin, and Arenac.

Ohio Valley Subsection of the West Virginia Section. Upon recommendation of Vice-President Allardt, Region V, the Executive Committee of the Council authorized the inclusion of Guernsey County in Ohio in the Territory of the Ohio Valley Subsection of the West Virginia Section.

Affiliation of the Milwaukee Section with the Engineers' Society of Milwaukee. Upon recommendation of Vice-President Dolan, Region VI, the Executive Committee of the Council authorized the affiliation of the ASME Milwaukee Section with the Engineers' Society of Milwaukee.

Affiliation of the Miami Section with the Engineers' Council of South Florida. Upon recommendation of Vice-President Little, Region IV, the Executive Committee of the Council authorized the affiliation of the ASME Miami Section with the Engineers' Council of South Florida.

Affiliation of the San Francisco Section with the San Francisco Engineering Council and the California Legislative Council of Professional Engineers. Upon recommendation of Vice-President Aurand, Region VII, the Executive Committee of the Council authorized the affiliation of the ASME San Francisco Section with the San Francisco Engineering Council and the California Legislative Council of Professional Engineers.

Affiliation of the Arizona Section with the Arizona Council of Engineering and Scientific Associations. Upon recommendation of Vice-President Aurand, Region VII, the Executive Committee of the Council authorized the affiliation of the ASME Arizona Section with the Arizona Council of Engineering and Scientific Associations.

Affiliation of the Rocky Mountain Section with the Colorado Engineering Council. Upon recommendation of Vice-President Grasse, Region VIII, the Executive Committee of the Council authorized the affiliation of the ASME Rocky Mountain Section with the Colorado Engineering Council.

Affiliation of the Fort Wayne Section with the Indiana Engineering Council, Inc. Upon recommendation of Vice-President Dolan, Region VI, the Executive Committee of the Council authorized the affiliation of the ASME Fort Wayne Section with the Indiana Engineering Council, Inc.

Affiliation of the Minnesota Section with the Minnesota Federation of Engineering Societies. Upon recommendation of Vice-President Dolan, Region VI, the Executive Committee of the Council authorized the affiliation of the ASME Minnesota Section with the Minnesota Federation of Engineering Societies.

Towne Lecture. General James M. Gavin, Executive Vice-President of Arthur D. Little, Inc., has been selected to present the Towne Lecture at the Management Luncheon on Tuesday, Dec. 1, 1959.

1960 Power Show. ASME Sponsorship. On recommendation of the Board on Technology, the Executive Committee of the Council approved participation in the 1960 Power Show to be held coincident with the 1960 ASME Annual Meeting in New York City.

William F. Durand. Last Will and Testament. The late Dr. William F. Durand, Honorary Member and Past President of the Society, bequeathed to the Society the following medals and awards: Naval Engineers, 1899; Guggenheim, 1935; John Fritz, 1935; Franklin, 1938; Carty (National Academy), 1944; ASME, 1945; Award of Merit (U. S.), 1948; and Wright Brothers Trophy, 1949. These awards and medals with the exception of the Wright Brothers Trophy, which will be forwarded to the Society at such time as it is located, are now in the vault of the Society.

Applied Mathematics and Mechanics (PMM). An additional sum of $10,000 has been granted by the National Science Foundation for support of the translation of the Russian publication "Applied Mathematics and Mechanics (PMM)."

Group Disability Insurance for ASME Members. Rider. A rider has been received for attachment to the master policy concerning addition of $500 deductible option to senior plan, becoming effective Sept. 1, 1959.

The Metallurgical Society of AIME. Appreciation for S. A. Tucker's Assistance. The following letter was received by the Secretary from R. W. Shearman, Secretary to The Metallurgical Society of AIME:

"As the services of Mr. Tucker with the Metallurgical Society on an informal basis were concluded on July 1, the Board of Directors of the Metallurgical Society passed a resolution at their meeting held on June 22, recommending Mr. Tucker for the able assistance that he has given to us. The resolution is quoted below:

"Whereas: Stanley A. Tucker has served for three years as Advertising Manager of Journal of Metals without compensation, and

"Whereas: Mr. Tucker has increased advertising revenue and put the organization of the advertising program on an efficient and effective basis,

"*Be it therefore resolved that:* The Board of Directors of The Metallurgical Society express their sincere thanks to Mr. Tucker and their great appreciation to The American Society of Mechanical Engineers for making Mr. Tucker's service possible during a critical period."

Hall of Fame for Great Americans. Candidates. The Council voted to submit the nomination of Thomas Alva Edison, Hon. Mem. ASME, to the Hall of Fame for Great Americans and that he be designated as engineer and inventor.

The Institution of Mechanical Engineers. 1959 James Watt International Medal. The recipient of the 1959 James Watt International Medal, for which the Society is asked to make nomination, was the late Sir Claude Gibb of England.

Joint Awards. 1959 Recipients of Awards in which the Society participates. Wallace Clark Award, Count Pierre Baruzy, Paris, France; John Fritz Medal, Gwilym A. Price, Pittsburgh, Pa.; Hoover Medal, Henry Townley Heald, New York, N. Y.; Marston Award, Murray Joslin, Chicago, Ill.; Alfred Nobel Prize, Paul Shewmon, Pittsburgh, Pa.; Elmer A. Sperry Award, de Havilland Aircraft Company, Ltd., England, for Sir Geoffrey de Havilland, President, C. C. Walker, then technical director and chief engineer; and Major Frank Halford, (in memoriam, then chairman and technical director). Certificate of citation given to co-workers. Washington Award, James R. Killian, Jr., Cambridge, Mass.

Engineering Institute of Canada. Appointment of Representative to ASME Council. Report is made of the appointment of A. G. Christie to serve as EIC representative to the ASME Council.

Certificates of Award. Board on Codes and Standards. Upon recommendation of the Standardization Committee and approval of the Board of Codes and Standards certificates for outstanding service in the development of codes and standards formulated under ASME sponsorship were awarded to: R. P. Hoelscher, Frank P. Tisch, I. H. Fullmer, and Newton C. Ewalt.

Upon recommendation of the ASA Sectional Committee B31 and approval of the Board on Codes and Standards, certificates for outstanding service in the development of codes and standards formulated under ASME sponsorship were awarded to L. W. Benoit, Sabin Crocker, C. A. Kelting, and V. T. Malcolm.

Regional Chairmen. Upon approval of their respective Vice-Presidents, certificates were presented to the following Regional Chairmen:

Region III—Robert E. Derby, Membership Development Committee, 1956–1959; and James B. Hartman, Mechanical Engineering Department Heads, 1958–1959.

Region IV—C. E. Trent, Student Sections Committee, 1956–1959; J. B. Lasley, Sections Committee, 1956–1959; and M. E. Kirkpatrick, Civic Affairs Committee, 1958–1959.

Region VI—Edward C. Lawson, Student Section Committee, 1956–1959; and Ronald J. Wohlwend, Junior Committee, 1957–1959.

Region VII—F. Wendell Beichley, Sections Committee, 1957–1959; Robert F. Steidel, Jr., Student Section Committee, 1957–1959; Elmer M. Johnston, Civic Affairs Committee, 1957–1959; and Francis R. Montgomery, Secretary, 1957–1959.

Region VIII—B. P. Robertson, Sections Committee, 1957–1959.

Section Chairmen. Upon initiation of their associates and approval of their respective Vice-Presidents, the following retired Section chairmen received certificates of award: 1957–1958: Berton S. McCarroll, Providence; Robert D. Merrill, Mohawk Valley; Donald S. King, Utah; R. W. Burgess, Baton Rouge Subsection; and Fred W. Bailey, Shreveport Subsection.

1958–1959: Erskine Vandegrift, Jr., Birmingham; E. L. Paulsen, Buffalo; L. F. Peckman, Central Illinois; Robert Nelsen, Cincinnati; Roy S. Peterson, Columbia Basin; J. H. Wilder, Dayton; Ralph W. Smith, Delaware; G. E. Hallen, Los Angeles; Lawrence Fried, Mohawk Valley; Leonard Lowder, Nebraska; E. M. Ketchie, Piedmont-Carolina; Frederick F. Tone, Rochester; Carl Dennis, Virginia; R. E. Philipps, Baton Rouge Subsection; R. A. Amos, Richmond Area Subsection; and Jere J. Austin, Santa Clare Valley Subsection.

Member Gifts Chairmen. A Certificate of Award has been presented to D. G. Jones, chairman of the Westmoreland Member Gifts Committee, as the Section that has attained its quota in dollars.

Appointments. Presidential. V. F. Estcourt, Durand Centennial Conference, Stanford University, Stanford, Calif., Aug. 5, 1959.

C. F. Kayan, 10th International Congress on Refrigeration, Copenhagen, Denmark, Aug. 19–26, 1959.

W. T. Alexander, Inauguration of President, Northeastern University, Boston, Mass., Sept. 8, 1959.

G. A. Breffeilh and R. C. Sogge, First Venezuelan Congress of Electrical and Mechanical Engineering, Caracas, Venezuela, S. A., Sept. 5–14, 1959.

G. J. Allman, Inauguration of President, University of West Virginia, Morgantown, W. Va., Oct. 3, 1959.

R. E. Abbott, F. H. Linley, Jr., and John Weiss, Tellers of Election, 1960 officers.

Deaths. The following deaths were reported: George A. Stetson, Editor-Emeritus of the Society, June 20, 1959; Clair B. Peck, Vice-President 1941–1943, Aug. 14, 1959; and Frederick S. Mallette, Executive Secretary to the Air Pollution Controls Committee, Sept. 10, 1959.

ENGINEERING SOCIETIES PERSONNEL SERVICE, INC
[Agency]

THESE items are listings of the Engineering Societies Personnel Service, Inc. This Service, which co-operates with the national societies of Civil, Electrical, Mechanical, and Mining, Metallurgical, and Petroleum Engineers, is available to all engineers, members or nonmembers, and is run on a nonprofit basis.

If you are interested in any of these listings, and are not registered, you may apply by letter or résumé and mail to the office nearest your place of residence, with the understanding that should you secure a position as a result of these listings you will pay the regular employment fee of 5 per cent of the first year's salary if a nonmember, or 4 per cent if a member. Also, that you will agree to sign our placement-fee agreement which will be mailed to you immediately, by our office, after receiving your application. In sending applications be sure to list the key and job number.

When making application for a position include eight cents in stamps for forwarding application to the employer and for returning when possible.

NEW YORK
8 West 40 St.

CHICAGO
29 East Madison St.

SAN FRANCISO
57 Post St.

Men Available[1]

New York Office

Mechanical Power-Plant Design and Project Engineer, PE; 40; 15 years of industrial and central station power-plant engineering experience. Prefers East or South. Presently employed. Me-759.

Project or Supervisory Engineer, BSME; 35; two years sales manager working with manufacturers' agents and 11 years process-piping engineering covering all phases of design for chemical-plants and oil-refinery units including technical writing. Location optional. Me-760.

Sales Engineer, BSME; 24; experienced in production, military specifications, quality control, law, customer liaison, and sales. Prefers covering New England. Me-761.

Technical Management or Staff, consumer or industrial-product fields; MSME; Registered. Over 10 years at chief engineer levels. Background includes domestic appliances, rotating machinery, internal-combustion power plants, materials handling, industrial-noise control, structural components, weapons, and food processing. Problem solving and policy-making experience in products, methods, and personnel-development areas. Prefers Midwest. Me-762.

Chicago Office

Chief Engineer, Plant Manager, Senior Project Engineer, BSCE; 32; four years chief engineer, major appliance manufacturer; one year chief product engineer, wire-specialty manufacturer; two years senior project engineer, air-conditioning manufacturer; one year chief manufacturing engineer, appliance and furniture manufacturer. Experience in setting up department, design and development responsibility for consumer products. Me-994-Chicago.

Director of Research and Development, BSME; 36; ten years in research and development engineering as project engineer, chief research engineer, and assistant vice-president of research and development in domestic furnaces, hoists, and vending machine components. Has established research and development offices. Worked with sales and customers. Prefers South or West. Me-1001-Chicago.

San Francisco Office

Operation, Installation—Heavy Industrial:

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[1] All men listed hold some form of ASME membership.

ME, 26. One year supervisory assembly, schedule, operations, inspect materials on equipment for sugar refining. Three months' experience drafting, preliminary designs, calculations, estimate cost on oil-seals manufacture. Six months machine operator. $450. Prefers West Coast, Midwest. Home: Texas. S(M)-1251.

Design, Estimate—Industrial Construction: MSME, 37, 11 years' experience on process and mechanical design including instrumentation, estimating, material specifications, drafting supervision on power plants, refineries, steel plants. $750. Licensed ME. in Calif. Prefers San Francisco Bay area. Home: Bay Area. S(M)-1166.

Design, Development—Petrochemical, Aircraft: ME, 42, 13 years supervision of design purchasing on pressure equipment, instruments, tools, test and process machinery for petrochemical research. Eight months design of ice-making and food-processing machinery for manufacturer. Four years field-service engineer, product revision, development, design, draft of aircraft accessories for manufacturer. One and one half years drafting instruments, hydraulic-test stand, and automatic scale-dividing engines for manufacturer. $1050 per month. Licensed ME in Calif. Prefers San Francisco East Bay. Home: East Bay. S(M)-1147.

Plant Manager—Metal Working: 51. Over 20 years full charge of production processes, purchasing, personnel, product design and development. $12,000–15,000. Prefers Calif., Nev. Home: Calif. S(M)-1056.

Engineering Executive. MSME, 39. Registered PE., 18 years supervision of mechanical, ordnance, and general engineering.. Now responsible for inspection engineering of rocket plant. Top Secret clearance. Foreign languages. Listed in Who's Who in Engineering. $18,000. Prefers U. S. or overseas. S(M)-1043.

Design, Draft—Air Conditioning, Process Piping: ME(China), 42. Five years design, draft air conditioning, heating equipment, process plant instrument design, heating equipment, tanks for consulting engineers. Two years studies of material substitutes, calculating materials, reports for elevators. Four years maintenance, operation of factory and power plant on tobacco products. $500-550 month. Prefers: San Francisco Bay area. Home: San Francisco. S(M)-992.

Project Engineer—Heavy, Light Industrial Construction: ME, 37, 12 years' broad experience in mechanical design, conventional and nuclear power plants, boiler plants, process industries, institutional mechanical facilities. Thermodynamic cycles, heat transfer, pumping systems, piping, pressure vessels, instrumentation and controls, water treatment, field plant start-up. $14,000. Prefers West. Home: Calif S(M)-956.

Production Manager—Small Manufacturing Plant: ME, 28. Two years' experience practical production and inventory control, scheduling, purchasing, storekeeping, traffic operations. Two years' experience industrial engineering, production methods, material flow, plant layout; with paper mill, bag, corrugated box operations. $8000. Prefers San Francisco Bay area. Home: Calif. S(M)-743.

Industrial Engineer—Metal Working: 42, 20 years' experience as industrial engineer to chief industrial engineer; time study, wage incentive, methods, cost, personnel, production, maintenance on manufacture of pipe, forgings, shops, mail order houses. $13,000. Prefers West. Home: Ill. S(M)-870.

Design, Stress—Machines, Mechanisms: ME, 30. Recent graduate interested in designing machines and mechanisms, structural analysis for various parts of machines. $500. Prefers San Francisco Bay area. Home: San Francisco. S(M)-714.

Design, Construction, Marine, Refrigeration, Air Conditioning. MSME, 33. Six and one-half years' experience construction, design, operation, familiar with marine diesel engines, steam turbines, refrigeration and air conditioning. Supervisory experience, good organization ability. $8500. Prefers West Coast, foreign. Home: Del. S(M)-369.

Plant Engineer—Food Process, Metal Working: ME, 31. Five years' diversified experience plant engineering, material-handling equipment, plant layout, plant facilities. Two years supervision of small plant engineering department. $7800. Prefers West Coast. Home: Mass. S(M)-466.

Design, Application—Heat Process: ME, 35. Good knowledge of heat-process calculations, fluid flow, control. Experienced industrial refrigeration, ventilation, air conditioning, dust

Keep Your ASME Records Up to Date

The ASME Secretary's Office depends on a master membership file to maintain contact with individual members. This file is referred to countless times every day as a source of information important to the Society and to the members involved. All other Society records are kept up to date by incorporating in them changes made in the master file.

The master file also indicates the Professional Divisions in which members have expressed an interest. Many Divisions issue newsletters, notices of conferences or meetings, and other material. You may express an interest in the Divisions (no more than three) from which you wish to receive any such information which might be published.

Your membership card includes key letters, below the designation of your grade of membership and year of election, which indicate the Divisions in which you have expressed an interest. Consult the form on this page for the Divisions to which these letters pertain. If you should wish to change the Divisions you have previously indicated, please so notify the Secretary.

It is highly important to you and to the Society to be certain that our master file indicates your current mailing address, business or professional-affiliation address, and interests in up to three Professional Divisions.

Please complete the form, being sure to check whether you wish mail sent to your residence or office address, and mail it to ASME, 29 West 39th Street, New York 18, New York.

Please Print

ASME Master-File Information

Date

LAST NAME FIRST NAME MIDDLE NAME

POSITION TITLE NATURE OF WORK DONE

e.g., Design Engineer, Supt. of Construction, Manager in Charge of Sales, etc.

NAME OF EMPLOYER (Give name in full) Division, if any

*☐ EMPLOYER'S ADDRESS City Zone State

ACTIVITY, PRODUCT, or SERVICE OF EMPLOYER; e.g., Turbine Mfrs., Management Consultants, Oil Refinery Contractors, Mfr's. Representative, etc.

*☐ HOME ADDRESS City Zone State

☐ PRIOR HOME ADDRESS City Zone State

* CHECK "FOR MAIL" ADDRESS

I subscribe to	*Address changes effective when received prior to:*
☐ MECHANICAL ENGINEERING	10th of preceding month
☐ *Journal of Engineering for Power*	20th of preceding month
☐ *Journal of Engineering for Industry*	
☐ *Journal of Heat Transfer*	
☐ *Journal of Basic Engineering*	
☐ *Journal of Applied Mechanics*	
☐ *Applied Mechanics Reviews*	1st of preceding month

Professional Divisions in which I am interested (no more than *three*) are marked X.

- ☐ A—Aviation
- ☐ B—Applied Mechanics
- ☐ C—Management
- ☐ D—Materials Handling
- ☐ E—Oil and Gas Power
- ☐ F—Fuels
- ☐ G—Safety
- ☐ H—Hydraulics
- ☐ I—Human Factors Group
- ☐ J—Metals Engineering
- ☐ K—Heat Transfer
- ☐ L—Process Industries
- ☐ M—Production Engineering
- ☐ N—Machine Design
- ☐ O—Lubrication
- ☐ P—Petroleum
- ☐ Q—Nuclear Engineering
- ☐ R—Railroad
- ☐ S—Power
- ☐ T—Textile
- ☐ U—Maintenance and Plant Engineering
- ☐ V—Gas Turbine Power
- ☐ W—Wood Industries
- ☐ Y—Rubber and Plastics
- ☐ Z—Instruments and Regulators

control, process heating, cooling and drying, automatic control, electric engineering and plant design. Salary open. Any location. Home: Pa. S(M)-460.

Junior Mechanical Engineer: ME, 25. Five and one-half weeks detail conveyer layout of small systems for manufacturer. $500. Prefers San Francisco Bay area. Home: San Francisco. S(M)-1563.

Design, Operation—Utility, Ventilation. ME, 52. Licensed EE and ME in Calif., 30 years' broad experience on design, installation, maintenance, operation of utility systems in commercial, industrial buildings, and areas including electric, water, heating, ventilation, air conditioning. $1000 month. Prefers Northern Calif. S(M)-795.

Research—Nuclear Reactors: ME, 36. Three and one-half years design, develop solid propellant gas generators, tests, reports, liaison, preliminary design. Five months drafting for naval shipyard. Two years design, develop flow-detecting devices in producing oil wells for oil company. $700. Prefers San Francisco Bay area. Home: Calif. S(M)-752.

Mechanical Machinery Design—Small mechanisms: ME, 33. Four years design of fully automatic printing calculator, office equipment for manufacturer. Five years' foreman of production department, time and motion study, tool design for office-equipment company. Part-time design of fiberglas-coating machine for pilot plant for construction company. $850. Prefers San Francisco East Bay. Home: East Bay. S(M)-705.

Positions Available

New York Office

Mechanical Engineers. (*a*) Mechanical graduate, up to four years' experience in medium, heavy machinery design or development in field of solids-liquid centrifuging and filtration. (*b*) Mechanical graduate, at least five years' mill or equipment manufacturing and design experience for pulp and paper preparation, machinery design, and application engineering. Will be assistant to division engineer. Duties will include application engineering on pulp and paper screens and cyclone separators, laboratory, and field testing of equipment, supervision of machine design, etc. Mass. W7577.

Chief Engineer, heavy experience in the hydraulic and mechanical fields, thoroughly familiar with pumps, valves, and related lines. To head up engineering department engaged in solving special application problems, and in the design and development of new products and product lines. $20,000, plus. New England. W7936.

Engineers, either recent graduate ME engineers with major in field of refrigeration and air conditioning, or those with experience in the industry for several years. Positions are principally of application of accessory items to refrigerated equipment of all sizes. Practical on-the-job training program after which applicants will be sent to other areas. Salary plus a bonus arrangement plus expenses. Headquarters, Midwest. W7943.

Engineer for large, progressive, multiplant graphic arts firm; graduate engineer, of mature judgment, up to five years' industrial-mechanical-engineering experience. Job functions include plant and manufacturing engineering and general survey work for top management. Plant layout, materials handling, equipment specifications, replacement and automation, plus methods improvement and economic analyses are included. Good salary; opportunity for advancement. Approximately 75 miles from N. Y. C. W7945.

Technical Editor, under 30, electrical or mechanical degree, and some design experience. Must be able to write fluently and well, and should show evidence of such ability. Duties include the procurement, selection, writing and editing of articles and feature departments for a national technical publication. Salary open. W7954.

Senior Industrial Engineer, graduate mechanical or industrial, at least 20 years' experience in education and manufacturing in heavy industry including foundries, machine and plate shop, welding, forming, etc. Professional teaching experience required covering management training, production planning, cost analyses, and general industrial-engineering courses. Ability to train and develop staff is an essential. Salary open. East. W7956.

Product Design and Development Engineers, mechanical or electrical graduates, experience in the design and development of consumer electrical appliances or allied fields. Good working knowledge of materials, Underwriter's requirements, heating devices, temperature controls, manufacturing methods, and costs. Creativity and real interest in product development work. To $10,000. Upstate N. Y. W7968.

Additional listings of positions and men available are maintained in the offices of E.S.P.S. Direct inquiries to nearest office. A weekly bulletin of engineering positions open is available at a subscription rate of $3.50 per quarter or $12 per annum for members; $4.50 per quarter or $14 per annum for nonmembers, payable in advance.

Management Personnel. (*a*) Manager, production engineering, 35-55, BS or MS in mechanical, chemical, civil, or industrial engineering, for administration of production engineering and coordination of this function with all other phases of manufacturing, sales engineering, and accounting. Must have growth potential. Should be experienced in production-engineering administration, production control, methods engineering, manufacturing engineering, and tool-room administration, as well as cost accounting. $10,000-$12,000. (*b*) Manager, metal working, 35–55, BS in engineering or equivalent experience, experience in metal-turning supervision at general foreman level. Experience and complete understanding of metal-working administration, labor standards, and work measurement. $9000-$12,000. Metropolitan N. J. W7978.

Field Sales Manager, 35-40, BSME, or BA, or equivalent, to supervise sales force selling printed cartons and other paper converted products in the Northeastern States. Must have five years' successful selling of printed cartons and boxes to industry; three years' field sales management, including planning, printing, and folded carton manufacturing experience, desirable. $15,000. Excellent opportunity. Some traveling. W7986.

Research Group Leader, mechanical graduate, textile equipment experience, for rapidly growing textile manufacturer in finishing fields. Salary commensurate with background. Midwest. W7992-C.

Packaging Engineer, BS in engineering and experience with flexible packaging materials for technical service and product application. Some traveling. $7200-$9600. Company will pay placement fee. New York, N. Y. W8000.

Chief Tool Engineer, graduate mechanical, 36-45, minimum of 15 years' experience in fields related to steel forging and heavy machining process. Must be familiar with budget and cost-control procedures, justification analyses and preventive maintenance programs. Will organize, staff-up and supervise a tool engineering department, consisting of the following functions: Tool and die design, tool and machine planning and procurement, tool facilities, machine repair and machine-tool process development. Liberal company benefits, bonuses and pension plan, life insurance, hospital coverage, etc. Pa. W8005.

Chief Engineer, engineering degree required, advanced degree desirable; at least 12 years' experience in design and development of turbo-compressors and pumps and reciprocating machinery, or related equipment. Must have exceptional administrative ability. Salary open; usual relocation and fringe benefits. East. W8010.

Engineers, mechanical and electrical graduates, in the area of plant and facilities design, young, for the design of new and renovated buildings including heating, plumbing, process piping, air conditioning, ventilating, wiring, etc. One to five years' similar design experience desired. $7000-$10,000. Mass. W8012.

Director or Vice-President of Engineering, for a small to medium-sized machine-tool manufacturer. Must be a graduate engineer; good supervisor with successful experience in transfer-line equipment as used in the automotive industry. To start, $20,000-$25,000, plus incentive. Midwest. W8021.

Mechanical Engineer for facilities engineering, graduate, five years' experience, to determine, prepare, and revise specifications for installed and ground powered mechanical equipment at base sites and design and modify such equipment to meet environmental conditions and requirements. Salary open. Company pays placement fee. N. J., with travel to foreign sites. W8028(*a*).

Engineer, Pump Division, 30-50, to take complete charge of design of centrifugal and reciprocating pumps. $10,000. Mid-Atlantic. W8029.

Sales Managers. (*a*) Waste-treatment equipment, to manage and expand sales of waste-treatment equipment for municipal and industrial applications in all aspects. Guide product development. (*b*) Pump Division, to manage and expand sale of portable, engine-driven pumps through distributors to contractors and others; guide product development. $10,000, plus. Mid-Atlantic. W8030.

Senior Industrial Engineer, 28-35, graduate industrial or mechanical engineer, three to five years' industrial-engineering experience, including the determination and application of standard data. Salary open. N. J. W8031.

Manager of Manufacturing, 35-40, degree in engineering or business administration, for a company specializing in sheet-metal products for buildings, offices, schools, and libraries, to supervise all line and staff functions pertaining to the actual manufacturing of the products. Must have knowledge of basic staff functions related to manufacturing such as industrial engineering, scheduling and production control, material-handling and storage-contract negotiations and interpretations, shipping, and raw material storage, etc. $12,000-$15,000. South. W8034.

Engineers. (*a*) Production engineers, graduate mechanical, minimum of experience, to be responsible for all phases of manufacturing engineering from final design stage to successful completion of project through final testing. Should be familiar with engineering design methods, tools and economic manufacturing processes. Will co-ordinate tool-engineering and production-engineering activities; act as liaison during pilot manufacture, etc. $7200–$11,000. (*b*) Process engineer, graduate mechanical, minimum of five years' experience in machine tools and processes, to act as a project leader and be responsible to tool engineer for part and assembly processing, basic tool and gage design, procurement and the successful operation of tools in service, prepare cost estimates for tooling and manufacturing of parts of complete units, etc. To $10,000. Company pays placement fees and aids in relocating. Upstate N. Y. W8040.

Safety Engineer, graduate mechanical, 26–40, to be responsible to the director of safety and health for the development of training programs and for accident investigations in alloy steel plant. To start, $6000-$7500. Md. W8042.

Chicago Office

Designer, graduate or equivalent, 35-45, five or more years' experience in high-speed automatic machine design, know plastic materials. Will design equipment to perform heat sealing, thermoforming, and plastic-on-paper applications to automatic machine design, for a manufacturer of paper products. Employer will pay placement fee. $10,000. Chicago. (Possible transfer to West Coast later.) C7707.

Sales Engineer, Combustion, five or more years' experience in industrial sales, know combustion gaseous fuels as well as oil. Duties: Sales engineer contacting chemical plants, steel plants, and all industrial users of combustion equipment. Must have ability to engineer and design special combustion problems as encountered in the field, travel. Employer will negotiate placement fee. $8000-$12,000. Car required. North Ill. and North Ind. C7717.

Designer, graduate ME, to 40; ten years' experience in engineering, eight of which have been in engineering and design of material-handling facilities for industries who process bulk materials such as iron ore, salt, limestone, etc., for a consultant. Employer will pay placement fee. About $10,000. Chicago. C7718.

Research and Development Engineer, graduate mechanical, 30-40; to assume responsibility for group engaged in research and development on metal-working processes and equipment. Experience in one of the following fields; rolling, stamping extrusion, drawing, etc., is necessary. Employer will pay placement fee. $8000-$12,000, depending on experience. Chicago area. C7719.

Design Engineers, degree necessary, six to ten years' experience in conception layout and design of tools, dies, fixtures and special machinery for shop and/or foundry use. Employer will pay placement fee. $7932-$11,100. Tenn. C7727 (*b*).

San Francisco Office

Assistant Scientist—Ice: ME, CE, or Physics. Experience in education in materials, particularly in experimentation. Applied mechanics desirable. Experiment in fields for which electromechanical instruments and equipment must be designed and built. Well experienced in mechanical properties of ice in field and lab and reduction of data and analysis. Experience in cold climate and geographical area other than metropolitan. First choice for single men. Advancement to faculty position may be expected. For geographic institute work in Alaska. About $7200 plus food, housing, clothing, transportation. S(P)-4743.

Cost Estimate, Design—Sheetmetal: ME background, 25-35. Six years' experience estimating, machining, welding, and sheetmetal fabrication primarily in diversified machining (aircraft experience desirable). Able to develop cost estimates on economical methods and machine applications for general machining, welding, and metal fabrication. Prepare bills of materials and specifications as well as drawings and sketches. Act as group leader. $635. San Francisco East Bay. S(P)-4738.

Maintenance, Operation—Construction Equipment: ME, 22-26. Recent graduate, to three years' experience with qualifications and interest in maintenance and operation of construction and material-handling equipment. Will participate in field-training program on construction sites. For large construction company. $500-550. San Francisco. S(P)-4734-R.

Plant Engineer—Paper Products: ME or equivalent, to 35. Should have had two to three years' plant-engineering experience handling projects, revisions, installation, and maintenance of machines and process equipment related to paper-mill continuous processes. Should be able to do some drafting, work with maintenance staff and outside contractors for paper-products manufacturer. About $600. San Francisco East Bay. S(P)-4730.

Maintenance—Paper Products. ME, 25-30. Recent graduate, to seven years' experience, preferably in plant engineering and maintenance of pulp and paper-process equipment, machinery, and plant, or closely related. For paper-board manufacturer. Salary commensurate. San Francisco East Bay. S(P)-4728.

Production Engineer—Heavy Electric Switchgear: ME, substantial experience in reviewing development, design, or revisions and able to have these converted to production drawings on existing material for cost reduction or new equipment going into production. Should know machine tolerances, materials, able to redesign for improved operation; familar with electric switching, knowledge of pneumatics, frame mountings, steel tanks, machine parts. Primarily an engineering-department production man with some experience in manufacturing industrial engineering. $9600. Los Angeles. S(P)-4719.

Estimator—Heating, Ventilating, Air Conditioning, Plumbing: Strong construction-estimating background, 40 to 50. At least four years' recent experience taking off and estimating commercial and large residential plumbing, heating, ventilating, and air conditioning for bid purposes. Should be able to handle annual volume up to a million dollars for contractor and engage in sales and promotion for construction business. $5000 base, 5 per cent commission on sales: estimated earnings $8000-$10,000. Nev. S(P)-4693.

Estimator, Take-off—Heavy Mechanical Equipment: ME background. Qualified by recent manufacturing experience to take-off from plans and specifications, make extensions, and assist in pricing on electrical, mechanical, and structural for heavy mechanical equipment (gates, hoists, cranes). For manufacturing shop. $500–$650. San Francisco East Bay. S(P)-4706.

Plant Engineer Assistant—Port Activity: ME preferred, or other engineering graduate; 30-40. Well qualified by experience to understudy plant engineer and able to deal with contractors, maintenance personnel, engineering firms, and management in matters relating to continued operation and maintenance of an existing facility, plus such new construction or modification as is required. On warehouses, bulk materials-handling plants, steam, water, and docking facilities. In addition, should be able to assist in design and direction of draftsmen. For port facility. About $750. Central Calif. S(P)-4691-R.

Designer—Cranes: Prefer ME, 30-40, with overhead crane experience, able to supervise structural and mechanical-design departments. Will be considered in near futures as chief engineer, if qualified. Salary open. Small engineering office. Northwest. S(P)-4690-R.

Plant Engineer—Mechanized Foods Plant: ME or IE, under 30. At least two years' recent experience in plant, knowledge of plant layout, methods, process, industrial-engineering, control of maintenance crews. Report to plant manager. Modern-sized production plant. New position, excellent opportunity. $600-750. San Francisco area men only. S(P)-4686-R.

Design—Materials Handling: ME, young. Experienced preparing installation and shop drawings from clients specifications on truck equipment, power tailgates, moving floors, special conveyers; should have knowledge of mechanical linkage, drives, shafting, bearings, hydraulic cylinder, and controls. For manufacturer $650-700. San Francisco East Bay. S(P) 4699.

CANDIDATES FOR MEMBERSHIP AND TRANSFER IN ASME

The application of each of the candidates listed below is to be voted on after Nov. 25, 1959, provided no objection thereto is made before that date and provided satisfactory replies have been received from the required number of references. Any member who has either comments or objections should write to the Secretary of The American Society of Mechanical Engineers immediately.

•New Applications and Transfers

Alabama

Coulter, Travis R., Jr., Birmingham
Rutledge, William S., Huntsville
● Smith, Bertran, R. Birmingham
● Snow, James, Tuscaloosa
Wolf, Robert K., Huntsville

California

● Balent, Ralph, Tarzana
Barr, William H., San Francisco
Cantoni, Ronald J., San Jose
Eistrat, Thomas, Alhambra
● Heisler, Sanford I., Daly City
● Kipp, David J., Los Angeles
● Kuhns, Robert M., San Diego
● Leung, Pui L., Pasadena
Montoya, Milward L., Berkeley
Nelsen, Hans H., Los Angeles
Oconnicof, William A., San Bruno
Rettaly, Guillermo, Los Angeles
Sanborn, Lewis M., Van Nuys
● Wu, Ning G., Berkeley

Colorado

● Schmidt, Alan F., Boulder

Connecticut

● Chasteen, Jack S., Stamford
Curtis, Henry F., Waterford
Defelippi, Joel J., Forestville
Richardson, David L., Windsor
Ryba, Daniel D., Milldale

Florida

● Deneen, Donald C., Warrington
Hill, Carlos E., Jr., Pensacola
Nye, Robert J., Tampa

Idaho

Fox, Charles H., Idaho Falls

Illinois

Barr, John M. C., Lisle
● Ellis, John T., Jr., Chicago
Hertwig, Henry F., Berwyn
Hoff, Oliver I., La Grange
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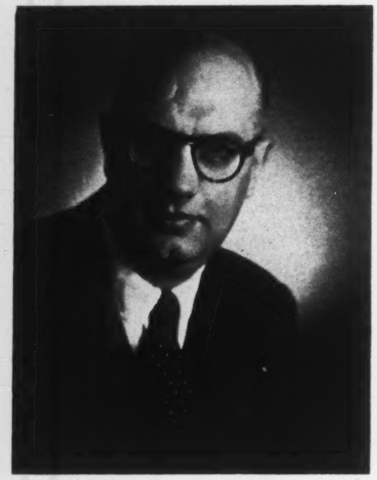
Frederick S. Mallette, Air-Pollution Controls Authority, Dies

Frederick Stephen Mallette, pioneer in the field of air-pollution controls and industrial hygiene, expert on legal phases of atmospheric-pollution problems, and executive secretary of the Air Pollution Controls Committee of The American Society of Mechanical Engineers, died September 10, 1959. In addition, Mr. Mallette was also editor of *Smog News*. From 1953 to 1955 he was Research Manager of the Society. His distinguished contribution in the field of air pollution was recognized in 1954 when he was invited to deliver the James Clayton Lecture before The Institution of Mechanical Engineers of Great Britain in London. His lecture was so well received that he was invited to lecture before groups of similar interest in Manchester and Glasgow.

Mr. Mallette's career began in the 1930's when he served as an authority for the United States Public Health Service. He had served as a consultant to state agencies and industry, at home and abroad, as well. In 1939 he was awarded a Mellon Institute Air Hygiene Fellowship. He joined the Firestone Tire & Rubber Company in 1942 where he was in charge of industrial hygiene and toxicology. In 1950, Mr. Mallette went to the American Steel & Wire Division of the United States Steel Company as assistant director of research in charge of air and stream-pollution control activities following the smog episode at Donora, Pa. He was asked in 1957 to conduct a survey of air-pollution problems in the tri-state metropolitan area by the Interstate Sanitation Commission. Mr. Mallette reported on the sources and degree of smog in New York, New Jersey, and Connecticut.

F. S. Mallette, Executive Secretary of ASME Air Pollution Controls Committee, died at his home in Riverside, Conn., Sept. 10, 1959.



Through his efforts the First International Congress on Air Pollution was arranged, and at the time of his death he was arranging for the second conference to be held in 1960. He had been vice-chairman of the ASTM Committee D-22 on Methods of Atmospheric Sampling and Analysis. He was a charter member and former secretary of the American Industrial Hygiene Association; and a member of the Chemical and Toxological Committee of the Industrial Hygiene Foundation. His published works include chapters in the National Safety Council's handbook of Industrial Safety and Dr. R. L. Kahn's book on tissue immunity, and numerous papers and book reviews in Mechanical Engineering, *Journal of Industrial Hygiene and Toxicology*, *Archives of Industrial Hygiene and Occupational Medicine*, and *Industrial Medicine*.

Mr. Mallette was born in New York in 1906. He received a BS degree from Michigan State Normal College; studied at the Universities of Michigan, Pittsburgh, and Chicago, and in 1946 received an MS degree from the latter. Surviving are his widow, Lita Mallette of Riverside, Conn.; and a brother, Dennis R. Mallette.

Mrs. Mallette has served as chairman of the Metropolitan Section of the Woman's Auxiliary to the ASME.

OBITUARIES

William Spencer Bowen (1886–1959), founder of the Bowen Engineering Company, North Branch, N. J., died Aug. 11, 1959. Born, Honolulu, T. H., Sept. 10, 1886. Parents, William A. and Emma Viola Bowen. Education, AB, Oberlin College, 1910; BS, Columbia University, 1916; ME, 1921. Married Esther Nichols Robson, 1911. Assoc. Mem. ASME, 1918; Mem. ASME, 1935. Mr. Bowen was one of the country's foremost authorities in the spray-drying field, a dehydration process widely used in the production of pharmaceuticals, blood plasma, chemicals, powdered milk, soluble coffee, and other products. Mr. Bowen held over 60 patents. He was a licensed professional engineer in New Jersey, New York, Pennsylvania, and West Virginia. Survived by his widow; a son, William A., St. Petersburg, Fla.; and two daughters, Mrs. Elizabeth Morse and Mrs. Jean Kepler.

Umbert Francis Corsini (1911–1959), general supt., Amer. Steel & Wire Div., U. S. Steel Corp., Donora, Pa., died May 10, 1959. Born, Plymouth, Mass., June 26, 1911. Parents, Gerardo and Elivra Corsini. Education, BS, Worcester Polytechnic Institute, 1933. Assoc. Mem. ASME, 1946.

William Wales Dashiell (1856–1947), chairman of the board, New York Lubricating Oil Co., New York, N. Y., died Aug. 2, 1947, according to a notice received by the Society. Born, Somerset County, Md., March 14, 1856. Education, ME, Stevens Institute of Technology, 1879. Mem. ASME, 1890.

James E. Entwhistle (1898–1959), design engineer, American Cystoscope Makers, Inc., New York, N. Y., died May 22, 1959. Born, Central Falls, R. I., July 4, 1898. Education, two-year mechanical engineering course, Brown University, 1930–1931. Mem. ASME, 1952. Mr. Entwhistle had been with American Cystoscope Makers since 1946. Survived by his widow.

Theodore Matthias Knoop (1879–1959), retired, Brooklyn, N. Y., died Aug. 5, 1959. Born, New Orleans, La., Dec. 17, 1879. Education, BE, Tulane University, 1901. Assoc. Mem. ASME, 1904; Mem. ASME, 1916. Mr. Knoop had for many years been employed by the Worthington Pump and Machinery Corp., and he was also associated with Otto Knoop Lumber & Realty Co. Survived by his widow.

Frank E. LeGates (1898–1959), chief inspector, Hartford Steam Boiler Inspection & Insurance Co., Cleveland, Ohio, died Aug. 1, 1959. Born, Farmington, Del., Feb. 20, 1898. Education, attended evening classes at M.I.T., and ICS. Mem. ASME, 1943. Mr. LeGates was a licensed professional engineer. He is survived by his wife, Florence; three daughters, Dorothy, Elaine, and Marjorie; two sisters, and a brother.

Jeremiah De Smet Maguire (1877–1959), chairman of the board, Federal Bank & Trust Co., New York, N. Y., died Aug. 18, 1959. Born, St. Louis, Mo., March 3, 1877. Parents, James C. and Bridget (Ryan) Maguire. Education, AB, Christian Bros. College, 1895; MEE, Cornell University, 1898. Mem. ASME, 1911. Mr. Maguire became associated with the Federation Bank in 1932, and was made chairman in 1944. He also was chairman of the Interstate Sanitary Commission for many years and chairman of the board of the Pierce Governor Co. He was a director of many organizations including the Continental Bank and Trust Co., the Merchants and Manufacturers Fire Insurance Co., and the Commerce and Industry Association of New York. Survived by his widow, Mrs. Sybil King Carbonelli Maguire; and a son, William T. Maguire.

Byron Benson Morton (1898–1959), development engineer, Research & Development Div., The International Nickel Co., New York, N. Y., died Aug. 14, 1959. Born, Pulaski, Va., May 12, 1898. Parents, Frank W. and Kathryn D. Morton. Education, BS(Met), Virginia Polytechnic Institute, 1925; post-graduate study at Louisiana State University. Married Margaret E. Young, 1927. Mem. ASME, 1936. Mr. Morton had done much metallurgical work for petroleum-industry applications. He was the author of several papers on the subject published in the technical press. He was a member also of ASME and API.

Clair Beach Peck (1884–1959), retired editor of *Railway Locomotives and Cars*, and former vice-president ASME, 1941–1943, Springfield, N. J., died Aug. 13, 1959. Born, Pierson, Mich., June, 1884. Parents, William H. and Clara (Beach) Peck. Education, BS(ME), Michigan Agricultural College, 1907. Married Mae Shoemaker, 1914 (d. 1955). Married 2nd, Elizabeth C. Tartas. Assoc. Mem. ASME, 1914; Mem. ASME, 1935; Fellow ASME, 1947. Mr. Peck joined the Simmons Boardman Publishing Co. in 1914. Prior to his retirement in 1954, Mr. Peck had served as mechanical department editor of *Railway Mechanical Engineer*, he also edited the *Locomotive Cyclopedia*, and the *Car Builders Cyclopedia*. Mr. Peck served the Society as a vice-president, and as chairman of the Railroad Division, Publications Committee, and Professional Divisions Committee. He was a member of Tau Beta Pi and Pi Tau Sigma. Survived by his widow; two daughters, Mrs. Elizabeth M. Kenney and Mrs. Helen M. White, and by two grandsons.

Edwin Dwight Smith (1877–1959), plant engineer, National Cash Register Co., Dayton, Ohio, died June 26, 1959. Born, Galion, Ohio, March, 1877. Education, BS(EE), University of Missouri, 1901. Mem. ASME, 1914. Married Lilliam Copeland, 1902 (d. 1917). Married 2nd, Nancy Vandeventer, 1919 (d. 1958). Mr. Smith had been with National Cash Register for 32 years. He was a former chief engineer of United Railway Co. and of the Mississippi River Power Distributing Co. He served for 14 years as president of the Oakwood board of Education. He had also been past-president and member for 22 years of the Board of Directors of the Miami Valley Hospital, Dayton. He was a registered professional engineer in the State of Ohio. Member also Tau Beta Pi. Survived by two daughters, Mrs. James D. Robinson of Dayton and Mrs. Maurine McCain of Atlanta, Ga.

Roger Alan Storholm (1935–1959), associate engineer, Missile Div., Douglas Aircraft Co., Santa Monica, Calif., died May 31, 1959. Born, San Diego, Calif., Nov. 9, 1935. Education, BS(ME), Stanford University, 1958. Assoc. Mem. ASME, 1958.

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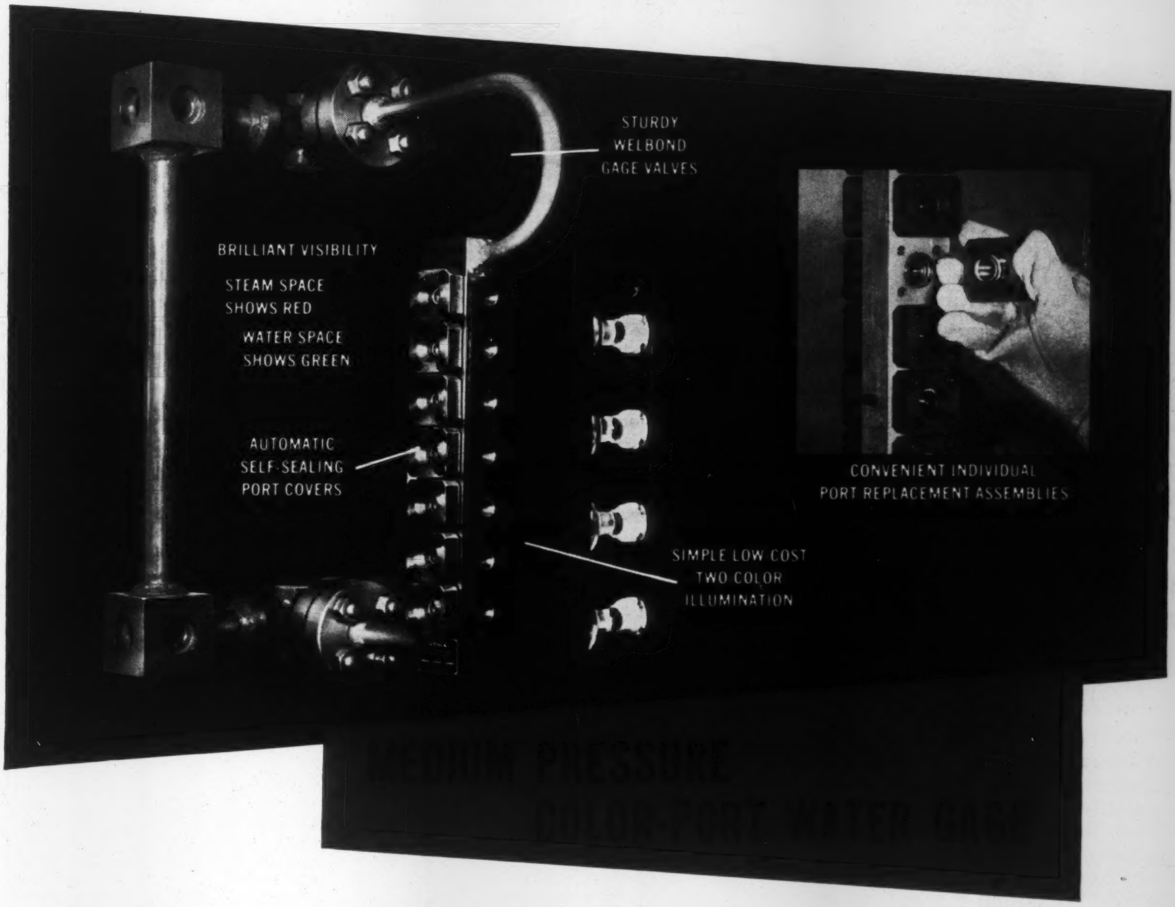
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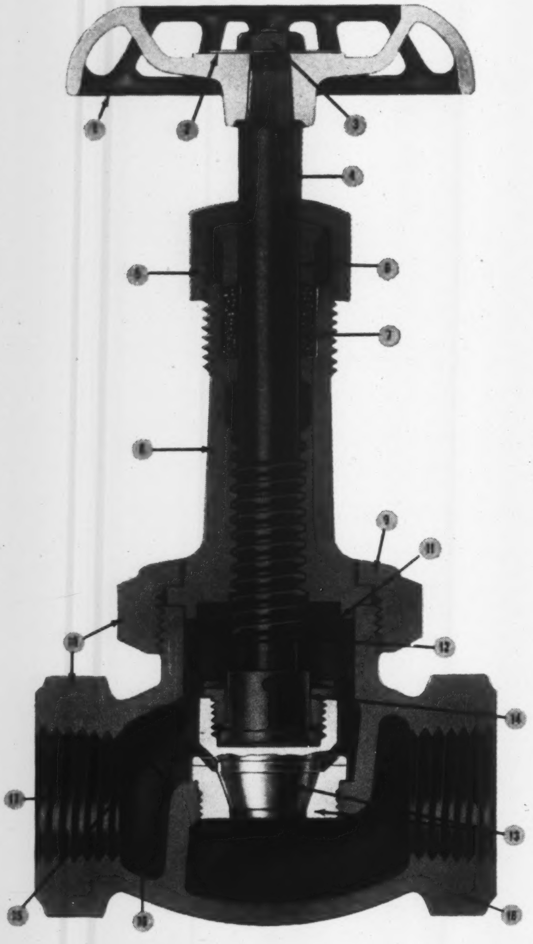

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1 ALLOY MECHANICAL TUBING

Babcock & Wilcox Co., Tubular Products Div.—Bulletin TB-430 is a primer on the use of alloy steel mechanical tubing. It describes structural, fabrication, and design advantages of tubing and gives tips on obtaining economies in the purchase of alloy steels in tube form.

2 FOUNDRY CUPOLA BLOWERS

Roots-Connersville Blower, Div. of Dresser Industries, Inc.—Bulletin FC-158 covers all FEMA listed standard sizes of iron cupolas. It gives the manufacturer's optional recommendations for suitable air blowers of either positive displacement or centrifugal type. Performance data is provided for all units at representative operating conditions. Automatic control systems for constant air weight are described and illustrated.

3 STEAM GENERATORS

Henry Vogt Machine Co.—Twelve-page Bulletin PSG-3 has line drawings, photos, and engineering data on portable type steam generators from 10,000 lb-hr capacity and above. Available in standard pressures of 175,250, and 375 psig.

4 VALVES

Wm. Powell Co.—A 24-page booklet describes bronze, iron, steel, special metal, and alloy valves for handling water, oil, gas, air, steam, and corrosive fluids. It lists materials and gives the type, pressure, temperature ratings, sizes.

5 ROLLER CHAIN

Acme Chain Corp.—Catalog No. 6 covers dimensions, list prices, engineering data, design suggestions for roller chain, double pitch chain attachments, cable chain, AL series and BL series, stainless steel chains, chain couplings, conveyor chains, bakery chains, and radius chains.

6 WELDING ALUMINUM

Aluminum Co. of America—A 176-page hard cover book gives basic, practical data on the various processes for welding aluminum with special emphasis on the inert gas methods. Included is guidance in selecting the process and the alloy. One chapter is devoted to the performance of welds. Illustrated, 32 tables. Form 10415.

7 PACKINGS

Johns-Manville—A 12-page brochure, PK-17A, contains a packings selection chart of rod, plunger, and valve stem packings; illustrations and descriptions of precision rings, hydraulic and groove packings, oil seals, metallic and cut gaskets.

8 REFRIGERATING MACHINE

American-Standard Industrial Div.—Bulletin 1426, a catalog describing the Tonrac single-stage hermetic centrifugal refrigerating machine, shows in cutaway construction details, including condenser, single-stage compressor, marine type water boxes, evaporator, tube bundle, float valve, lubrication system, motor and purge system.

9 MACHINERY LUBRICATION

Lubriplate Div., Fiske Bros. Refining Co.—A 36-page data book gives information on proper lubrication of all types of machinery. Included is data on improvement of machine operations, reduction of power consumption and lowering of maintenance costs through specialized lubricants.

10 DESUPERHEATER

Copes-Vulcan Div., Blaw-Knox Co.—Bulletin 1037 illustrates and describes a variable-orifice desuperheater that holds reduced steam temperatures constant within 20 ft of outlet, even over load range as wide as 50 to 1. The unit needs no atomizing steam, no long downstream piping runs. Permanent pressure loss is 3 to 4 psig on all flows.

11 FLEXIBLE CUSHION COUPLINGS

Dodge Mfg. Co.—An expanded line of Para-flex flexible cushion couplings ranging from fractional to 190 hp per 100 rpm is described in a 12-page bulletin. Two new sizes have been added to the 10 previously offered. New PX24, largest in the line, is capable of delivering up to 2000 hp at 1080 rpm.

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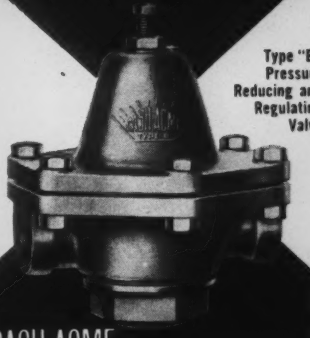

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YOUR *New Catalogs* GUIDE

12 POWER TRANSMISSION

Twin Disc Clutch Co.—A 20-page catalog covers industrial clutches $2^{1}/_{2}$ through 42 in. in diameter. Fluid couplings, single stage torque converters, and three stage torque converters are discussed. Torque and horsepower ratings, dimensional data is included.

13 NEW PROCESS PUMPS

Goulds Pumps, Inc.—Eight-page Bulletin 724.1 describes two new process pumps designed for petroleum refinery, petrochemical and related industries. Fig. 3775 is an enclosed-impeller type centrifugal pump; Fig. 3675 is a close-coupled version of Fig. 3775. Both come in 11 sizes with capacities up to 850 gpm and working pressures to 550 psi.

14 BELLOWS EXPANSION JOINTS

Tube Turns—Bulletin TT943 explains new rating concept based on minimum assured cyclic life predicated on empirical evaluation of the interrelation between traverse, pressure, and cyclic behavior. It also gives dimensional data and rating tables for 50 and 150-lb bellows expansion joints, sizes 3 through 30 in.

15 CENTRIFUGAL CASTINGS

Sandusky Foundry & Machine Co.—Bulletin No. 300 illustrates growing use of centrifugally cast cylinders in unfired pressure vessels, nuclear power, and other critical applications. Listed are typical ASME code-approved, ASTM, and military specifications for high-alloy, low-alloy, and carbon steels used in producing 14 recent applications. Specification minimum and actual physical properties, given in comparative tables.

16 BALL BEARINGS

Aetna Ball & Roller Bearing Co.—Catalog covers AG series of low cost, compact, mounted anti-friction units, including adapter bearings (flange units), sprocket and belt idlers incorporating ball bearings, miscellaneous flanged units. Tables give dimensions and application data.

17 PLASTIC PIPE FITTINGS

Grinnell Co.—A 16-page catalog on corrosion resistant pipe fittings, flanges, valves and pipe in normal impact grade and high impact grade, rigid, unplasticized polyvinyl chloride shows characteristics, advantages and limitations. Listed are operating pressures, temperatures, applications, price comparisons, fabrication advice, installation and supporting recommendations, dimensions and weights.

18 SQUARE HEAD CYLINDERS

Anker-Holth Div., Wellman Engrg. Co—A 30-page data bulletin gives engineering specifications, ordering information for recently-introduced square head hydraulic cylinder line. Of tie-rod construction, line is rated for 2000 psi working pressures, up to 3000 psi in nonshock service. All mountings are available, standard bores range from $1^{1}/_{2}$ through 12 in. Standardized mountings are said to provide complete interchangeability with most makes of square head cylinders.

19 SELF-ALIGNING COUPLINGS

Koppers Co., Metal Products Div.—A 16-page brochure describes principles and features of Fast's self-aligning couplings. Illustrates and describes each available standard and special model. Also available are four-page folders on Model B, forged steel, cast steel, mill motor flex-rigid and breaking-pin Jordan couplings.

20 CONSTANT TEMPERATURE PUMPS

Dean Brothers Pumps Inc.—Circular 195 describes new line of standard constant temperature pumps, Types CT-C and CT-R, for maintaining process temperatures when pumping of liquids which congeal, solidify or crystallize with loss of heat. Sectional views illustrate two methods of applying heat to pump: tracing and jacketing.

21 UNDERGROUND PIPE INSULATION

American Gilsonite Co.—A four-page bulletin gives tips on the uses and installation of a new insulation for hot underground pipes. It explains how the material protects pipes against corrosion caused by acids and alkaline ground waters, and against bacterial action, roots and electrolysis.

YOUR New Catalogs GUIDE

22 MANUAL, SOLENOID VALVES

Barksdale Valves.—Catalog 59-60 covers manual, foot-operated, and solenoid valves. Manual and foot-operated valves are 4-way, shut-off, manipulator, and dual pressure. Solenoid models include 4-way, 3-way, shut-off and diverter valve series.

23 DUST, FUME COLLECTORS

Northern Blower Co.—Bulletin 164 describes automatic bag type arresters, diagrams standard dimension factors and supplies table of dimensions and capacities. Separate additional bulletins contain similar data for standard bag type (not automatic), hydraulic type, centrifugal type, and portable dust collectors.

24 LUBRICANTS, COMPOUNDS

Shell Oil Co.—A series of folders gives data on properties, testing, applications of a new atomic power lubricating grease, an extreme temperature range lubricant or missile applications, an emulsion-type lubricant for large low-speed diesel engines, compounds and fluids for open gears under extreme pressure loads, and the company's oil-print analysis for field diagnosis of motor oils.

25 STATIONARY COMPRESSOR

Joy Mfg. Co.—Bulletin A-62 describes WN-112 heavy-duty, two-cylinder stationary compressor. The booklet contains specifications, diagrams, cross section drawings, installation photographs on the unit built for continuous, 24-hour service for pressures to 125 psi and piston displacements from 468 to 974 cfm.

26 VERTICAL SUCTION HEATER

Davis Engineering, Div. of American Metal Products Co.—Four-page bulletin describes and gives design and size capacity tables on new Paracoil type VUF vertical tank suction heater for installation in underground storage tanks. The heater is suspended from a tank manhole, with all service connections outside the tank.

27 FLUID POWER EQUIPMENT

Oilgear Co.—Bulletin 10051-H covers variable delivery, constant delivery, and automatic feed pumps; constant and variable speed transmissions; constant and variable displacement motors; fluid power cylinders; servo components; directional, relief, foot, and surge valves; additional valves and accessories.

28 HEAT EXCHANGER TUBES

Aluminum Co. of America—Illustrated catalog contains relevant data on Alcoa aluminum heat exchanger tubes. Covers advantages, fabrication, application in petroleum and petrochemical industries, chemical, steam, atmospheric, air, and gas. Also use of aluminum alloys, fluid flow characteristics, heat transfer characteristics, resistance to corrosion specifications and data with tables. Form 10186.

29 GASKETS

Garlock Packing Co.—Bulletin AD-104 describes the firm's Guardian spiral wound metal gaskets. The bulletin details features and design factors of the metal gaskets as well as the types available for specific applications.

30 VIBRATING SEPARATORS

Southwestern Engrg. Co.—Catalog describing 18, 30, and 48 in. vibrating screen separators. It presents operating, application, and specification data on screening all types of dry materials and separation of solids from liquids in your industry.

31 BRONZE BEARINGS

Bunting Brass & Bronze Co.—Catalog 258 lists 343 stock sizes of cast bronze electric motor bearings for all makes and sizes of electric motors. These are made exactly to dimensions of original equipment and fit without further finishing.

32 ENGINE POWER TAKE-OFFS

Rockford Clutch Div., Borg-Warner Corp.—Circular is available containing illustrations, line drawings, description, and complete information on size and capacity of this unit designed for especially rugged heavy-duty service, operates without a pilot bearing and requires lubrication only once per year.

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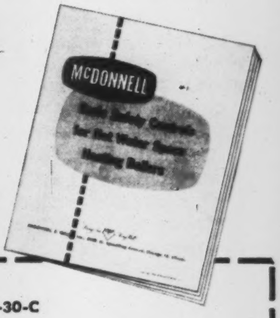

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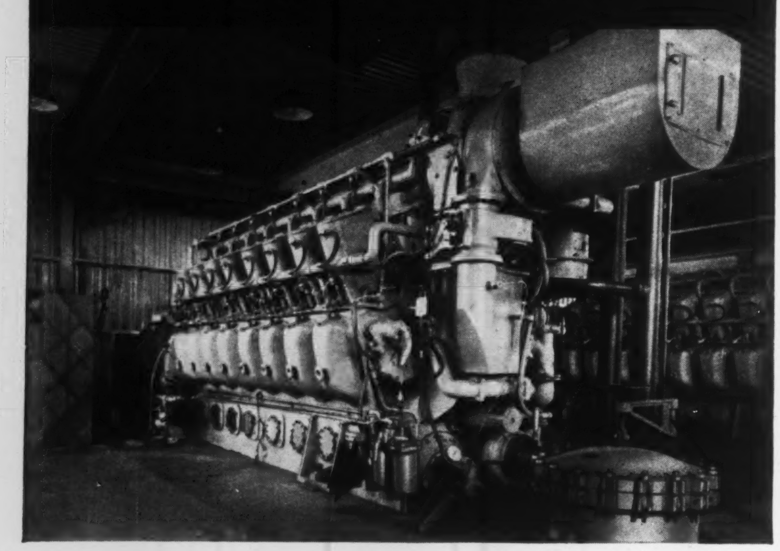

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YOUR New Catalogs GUIDE

33 PLANT ENGINEERING EQUIPMENT

B-I-F- Industries, Inc.—Bulletin B-I-F 5-2 provides information and illustrations of the firm's line of process instrumentation and equipment for positive control of materials in motion. Included are meters, feeders, valves, weighers, instrumentation, controls, and systems.

34 CONDENSER HANDBOOK

C. H. Wheeler Mfg. Co.—A 38-page condenser handbook offers simple methods of calculating steam condenser performance. Included are basic formulas for calculating heat transfer coefficient, cooling water flow rate, condensing surface and other data.

35 CONTROL VALVES

A. W. Cash Co.—Four-page bulletin describes the firm's quality control program applied to 6000 series control valves for gas-steam-fluid. It covers such functions as castings analysis, hardness, production tolerances for parts interchangeability, inspection, in-plant testing. Lists basic applications and specifications.

36 PLASTICS RESINS

E. I. duPont de Nemours & Co.—Catalog A-11550 illustrates and describes characteristics, forming and working techniques, and end-use applications of Delrin acetal resin, Zytel nylon resin. Alathon polyethylene resins and Lucite acrylic resin. Detailed properties charts are listed.

37 GAGING CARTRIDGES

Sheffield Corp.—A 32-page booklet gives application data on the use of Plumjet air gaging cartridges with instruments. Included are types, sizes, amplification tolerance, and range of the units. Engineering and technical data for applying them to single and multiple dimension inspection and machine control is included.

38 PACKAGED STEAM GENERATOR

Foster Wheeler Corp.—Bulletin PG-59-4 details components, construction, and performance of new coal-fired packaged steam generator. Standard sizes of 43,000, 50,000 and 63,000 lb per hr, 250 psi now available.

39 LOADING ASSEMBLIES

Jordan Industrial Sales Div. of OPW Corp.—A 24-page Catalog F-32R describes loading assemblies and accessory products. The catalog contains detailed product descriptions and photos, engineering information, dimensional drawings, installation layouts, and selection instructions.

40 IMPLEMENT BALL BEARINGS

New Departure Div., General Motors Corp.—A booklet illustrates and describes ball bearings for use on farm implements. The 24-page booklet has cutaway photos, drawings, dimension, load rating tables for a variety of farm applications.

41 MILLING, GRINDING MACHINES

Cincinnati Milling Machine Co.—Illustrated catalog of 72 pages describes and gives specifications on the firm's line of machine tools for milling, grinding, broaching, cutter and tool grinding, and special machine tools. Machines for selective hardening and metal forming are covered and information about the firm's grinding wheels and cutting fluid is given.

42 MECHANICAL POWER TRANSMISSION

Worthington Corp.—Eight-page catalog lists various mechanical power transmission and variable speed drive products. Bulletin 7900-B2 includes descriptions of all products and references for additional information regarding selection and application.

43 QUICK OPENING DOORS

Struthers Wells Corp.—Bulletin SW-553 covers quick opening doors for processing equipment. Automatic or semi-automatic in operation, the units are available in Ring-lok or Wedg-lok types, designed for vulcanizers, devulcanizers, impregnators, sterilizers, cement block curing vessels, ovens, and creosoting cylinders.

YOUR

New Catalogs GUIDE

44 FORGINGS

Bethlehem Steel Co.—Folder 662 describes the highly-specialized production of the 109-lb aircraft forgings used to attach wings to air frames of the USAF twin-jet, "Voodoo."

45 PILOT OPERATED REDUCING VALVE

Fisher Governor Co.—Bulletin D-92B describes governor pilot operated steam pressure reducing valves, available in sizes from 1/2 through 2 in., with 250 lb screwed connections and 1 1/2 through 6 in. in 125 or 250 lb flanged connections. It is a self-contained unit, obtaining pilot operating medium from the inlet.

46 THERMOCOUPLES

Aero Research Instrument Co.—Catalog describes AerOpak thermocouple wire, thermocouples, and insulated electrical conductors for use from −400 to 3000 F operation. Diameters are .025 to .313 in. The wire can be formed to a radius equal to sheath diameter and weldments can be performed without loss of insulation; it withstands pressures upwards of 50,000 psi.

47 SLIDE RULE

Eugene Dietzgen Co.—Four-page literature piece describes the company's new pocket slide rule. This rule is furnished complete with a leather case, rustproof stainless steel pocket clip, instruction manual. The rule contains the K, A, B, T, ST, S, D, DI scales on one side and the DF, CF, CIF, CI, C, D, L scales on the other side.

48 LIFT TRUCK SCALE MODELS

Materials Handling Div., Yale & Towne Mfg. Co.—Three-dimensional plastic or metal models and two-dimensional templates (1/4 in. scale) are offered for this firm's entire industrial lift truck line as visual aids for planning with plant mock-ups or scale drawings.

49 RAILROAD BEARINGS

S K F Industries—Form 483 lists and describes journal roller bearings for general and special purpose freight cars, passenger cars, locomotives, subway, multiple unit, and self-propelled cars; traction motor armature bearings, diesel locomotive generator bearings; and the firm's traction motor bearing inspection and service program.

50 CORRUGATED ROOFING, SIDING

Philip Carey Mfg. Co.—Form 6300 illustrates corrugated asbestos-cement roofing and siding composed of Portland cement and asbestos fibres combined under pressure to form a homogeneous, monolithic sheet. The material is highly resistant to fire, acid and alkali fumes, salt air, rot proof and rodent proof. It never needs painting, but can be painted. Because deep corrugations provide beautiful shadow effects, it is often used for decorative purposes.

51 COPPER TUBING HANGERS

Grinnell Co.—A 12-page catalog, CTH-56, covers hangers and supports for copper tubing. All hangers are copper plated and accurately sized to fit standard copper tubing. Data is also included on packaged quantities.

52 CLOSE COUPLED PUMPS

Warren Pumps, Inc.—Bulletin 242 features Compacunit close-coupled centrifugal pumps for general water service, boiler feed, air conditioning, booster, and condensate. The eight-page bulletin includes detailed specifications, sectional views, selection table, and outline dimensions.

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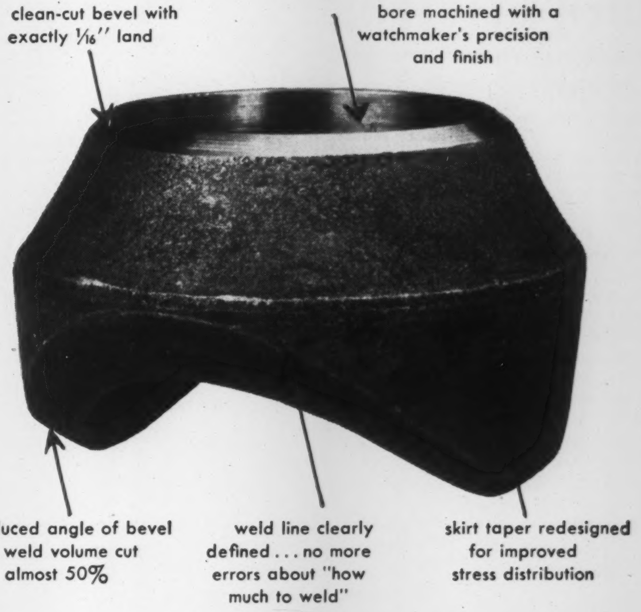
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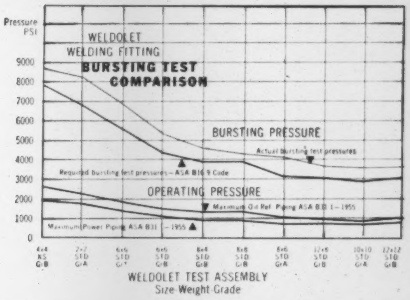

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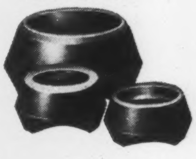

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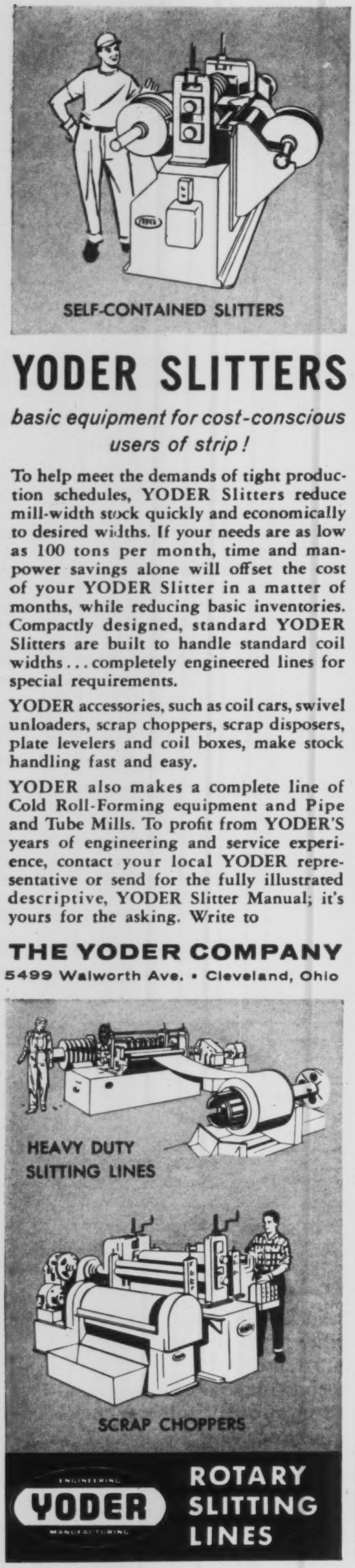

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LATEST INDUSTRIAL LITERATURE

53 HEAT EXCHANGERS

Southwestern Engineering Co.—A catalog describes heat exchangers and pressure vessels which are designed, engineered, and manufactured for the process and power industries. Photographs and diagrams illustrate basic types and other special process and power equipment such as feed water heaters, surface condensers and steam jet ejectors.

54 V-BELT DRIVES

Dayton Industrial Products Co., Div. of Dayton Rubber Co.—Supplement to handbook of V-belt drive design gives detailed tables based on recently increased drive horsepower ratings. Findings of long-term university research project are reported to have established new ratings as high as 2 to 3 times the former ratings.

55 HERRINGBONE GEAR REDUCERS

Jones Machinery Div., Hewitt-Robins—A 160-page catalog gives specifications on single, double, and triple reduction herringbone gear reducers, including overhung loads. The units have alloy iron housings and alloy steel gearing, and all pinions are integral with shafts. Size ranges up to 1950 ph; ratios up to 255.8 : 1.

56 STEAM GENERATOR

Ames Iron Wks, Inc.—Bulletin AA-1 describes advantages of a newly designed low pressure air atomizing burner and new gas ring burner. The Model AA incorporates a 3-pass concentric tube design, single one-piece baffle, and one-piece flue covers.

57 VIBRATION, NOISE CONTROL

Korfund Co.—Eight-page booklet K4E gives engineering specifications and performance data for 27 types of products for the control and measurement of machinery vibration, shock, and noise. Installation photos show a variety of equipments and tell how typical problems were solved.

58 BUTTERFLY VALVE

Henry Pratt Co.—Catalog No. 10Z illustrates and describes a new type of flangeless rubber seat butterfly valve. Included are dimensions of all sizes, instructions for choosing proper size, operators, and material combinations, water and air flow data and price sheets.

59 CORROSION RESISTING PLASTIC

Joseph T. Ryerson & Son, Inc.—Technical Bulletin 80-3 provides engineering data on Ryertex-Omicron PVC plastic. Included are tables of properties, advantages, chemical resistance to various media, fabricating instructions, pipe installation suggestions, bar, pipe, and sheet sizes, and illustrations of applications.

60 POWER TRANSMISSION PRODUCTS

Boston Gear Wks.—A 664-page, pocket-sized Catalog No. 57 contains information on 9496 standardized power transmission products and 58 pages of engineering tables, formulas, and descriptive text.

61 LIQUID LEVEL, FLOW CONTROL

McDonnell & Miller, Inc.—A 24-page booklet provides engineering information, schematic drawings on how to provide operating and safety controls for a variety of jobs involving liquid level and liquid flow.

62 EXPANSION JOINTS

Badger Mfg. Co.—Six-page bulletin on S-R expansion joints contains general information on flanges, liners, covers, temperature ratings.

63 ROTARY PUMPS

Viking Pump Co.—Eight-page Catalog 59-S includes illustrations and specifications on general purpose and heavy-duty rotary pumps. Capacities range from $^{1}/_{3}$ to 1050 gpm, pressures up to 200 psi on heavy-duty models.

64 POWER LUBRICATION

Lincoln Engrg. Co—Eight-page brochure describes and illustrates the latest development in power operated lubrication systems, both automatically (full and semi-) and manually timed. These systems are designed for application on existing facilities or original equipment.

65 SPUN STEEL TUBING

American Cast Iron Pipe Co.—Illustrated 64-page catalog describes special products division facilities, the centrifugal spinning process, its advantages and illustrates versatility of application of tubes. It contains tables, technical data, engineering information for stainless and carbon steel tubes 2.25-50 in. od.

66 AIR COMPRESSORS

Gardner-Denver Co.—Twelve-page bulletin illustrates and describes two-stage water-cooled air compressors for use throughout general industry.

67 SNOW MELTER

Thermal Research & Engineering Corp.—A newly developed snow melting system is described in Bulletin 117. This system uses submerged combustion in a pit or tank to heat water with high turbulence. Snow is plowed or dumped into the pit where it immediately melts. Sizes up to 25 tons per hour of snow are described. Instructions on figuring particular snow loads are given.

68 DUCTILE IRON REGULATORS

OPW-Jordan—Four-page bulletin describes composition, properties, specifications, comparison tables on steel, cast iron, and red brass, and the results of a severe quence test on ductile iron valves.

69 FLASH BUTT-WELDING RINGS

American Welding & Mfg. Co.—A 20-page illustrated booklet describes how the firm produces rings and circular products. Photographs, drawings, and charts illustrate the methods used to form bar stock by bending and how it is welded to produce rings used in aircraft, missile, and other industrial applications. Specifications peculiar to flash butt-welded rings, quality control procedures, and testing are discussed.

70 STAINLESS, SPECIAL PURPOSE ALLOYS

Carpenter Steel Co.—A 12-page booklet contains information on selection, properties, corrosion resistance and workability of stainless steels. Also included is a description of alloys available for electronic, magnetic and electrical applications, and alloys for elevated temperature service.

71 WATER COLUMNS, GAGES

Ernst Water Column & Gage Co.—Bulletin 8-13-58 illustrates and gives specifications of bronze gages, flow indicators, water columns, steel gages and valves, gage glasses and gaskets.

Read carefully . . . select wisely, then send coupon on page 140 now for your free catalogs. Requests limited to 25 catalogs. (Sorry, no catalog distribution can be made to Students.)

YOUR *New Catalogs* GUIDE

72 CUSTOM MOLDING TEFLON

Sparta Mfg. Co.—A four-page brochure covers patented process of custom molding parts of Teflon in thin sections and shapes. Properties and characteristics of Teflon, suggested end uses, and illustrations of such parts designed through the process as cup, ball, or shaft seals, washers, gaskets and diaphragms are included.

73 SURFACE CONDENSERS

Worthington Corp.—Bulletin W-200-B3A shows applications of surface condensers for steam power stations, industrial processes, marine and water works service.

74 BOILER SERVICE VALVES

Everlasting Valve Co.—Bulletin describes the Everlasting Quick-Opening and Slow-Opening Straightway Valves, Angle Valves, Y-Valves, and Duplex Blow-Off Units, with specifications, materials of construction, and dimensions of each type. Illustrations include details of design, sectional and exploded views, and explanations of operation of the valves. A section of the bulletin also describes Everlasting Valves for the protection.

75 HYDRAULIC MACHINERY

Watson-Stillman Press Div., Farrel-Birmingham Co.—A 24-page bulletin gives information on injection, compression, and transfer molding machines for the plastics industry; extrusion presses for ferrous and nonferrous metals; metalworking equipment; railroad shop equipment; ordnance equipment; standard and special machinery for general industrial applications.

76 COPPER ALLOYS

American Brass Co.—An enlarged edition of its "Copper & Copper Alloy Specifications Index" lists the most generally used alloys and products of the company, together with the applicable specifications of the eight following agencies ASTM, ASME, AWS, SAE, AMS, Federal Military, and Joint Army-Navy.

77 PROPELLER, MIXED FLOW PUMPS

Layne & Bowler, Inc.—Bulletin 350 includes propeller and mixed flow pumps with cut-away application photos and performance charts.

78 PIPE HANGERS

National Valve & Mfg. Co.—Bulletin 157 gives specifications for Counterpoise hangers, designed to provide a constant load supporting capacity for piping systems subject to vertical movement caused by expansion and contraction of piping with temperature changes. Levelglide hangers, which permit horizontal movement of piping systems, also are described.

79 DEAERATING HEATERS

Graver Water Conditioning Co.—Bulletin, WC-106A, on tray type deaerating heaters covers principles of deaeration; tray heater operation; standard heater design and applications; accessory equipment, and design and fabrication of tray utility heaters.

80 DATA PROCESSING

Consolidated Electrodynamics Corp.—Technical bulletins describe MicroSADIC analog-to-digital conversion equipment, recording oscillographs, amplifying systems, and direct-writing oscillographs. Operating information and description of applications are also included. Bulletin Nos. 3004, 1585A, 1536B, 1500D, 1598B, 1522D, and 1589 are offered.

81 IN-LINE ENGINES

Nordberg Mfg. Co.—Bulletin 257A describes four cycle diesel, Duafuel and spark-ignition gas engines. Installations discussed include municipal and industrial power plants, pipe line pumping stations and marine propulsion and auxiliary service.

82 SPECIAL SERVICE HOSE

Raybestos-Manhattan, Inc.—Manhattan Rubber Div.—Catalog M680 gives information on features, construction, sizes, fittings and materials used in special service hose. Application photos show the hose in use in various industries.

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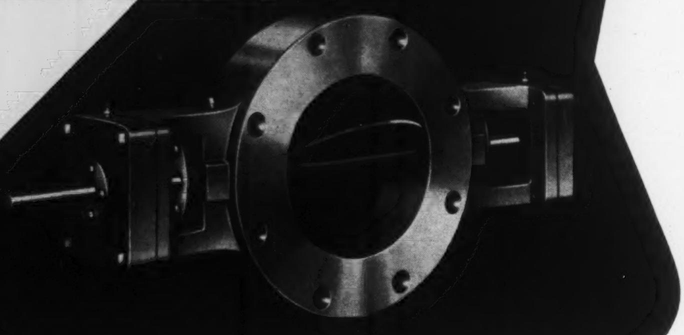

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ROTOVALVES

WAFER VALVES......

Here's a new wafer valve—with Allis-Chalmers full-bodied design—that incorporates many of the highly-desirable features of two-flanged butterfly valves.

Rugged Construction—A-C full-bodied design affords full protection; there is no chance of cracking around bolt holes. Vanes are pinned to stainless or monel shafts with high-tensile pins. Oversized outboard roller bearings and retaining plates are used. Rugged standard mounting brackets provide maximum support for any operator in any position.

Flexibility—Valves can be provided in a wide variety of alloys to handle all types of fluids and semi-solids over a wide temperature and pressure range. They may be equipped with almost any operator, which may be mounted in several positions on standard A-C bracket assemblies.

Through Rubber Seats—Full rubber seats on A-C Wafer Valves afford maximum body protection and positive, bubble-tight shutoff. Standard seats are of natural gum rubber, neoprene or hycar. Other materials are available on request.

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For information on the complete line of Rotovalves, and butterfly, ball and wafer valves, contact your nearest A-C valve representative, or write Allis-Chalmers, Hydraulic Division, York, Penna.

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YOUR *New Catalogs* GUIDE

83 CYLINDERS, CONTROLS

Westinghouse Air Brake Co., Industrial Products Div.—Three bulletins are offered. F9-180.00 covers basic pneumatic air controls; DO-OO-2 lists catalogs covering the division's line of products; D3-41.01 describes double acting, cushioned and non-cushioned streamlined cylinders.

84 TOOL STEELS

Crucible Steel Co. of America—Forty-six pages of information concerning tool steels for forging operation, the die casting process and the hot extrusion process. A series of charts detail the tool steel and heat treatments recommended for numerous forging, die casting, and extrusion operations. Also included is a brief trouble shooting guide.

85 STEAM TRAPS, FLUID SPECIALTIES

V. D. Anderson Co.—A 36-page catalog contains engineering information on sizing steam traps, strainers, air release valves, and line type purifiers. Specifications, capacities sizes, pressures, weights on inverted bucket, thermostatic, float, combination and high pressure steam traps and other fluid specialties are given. Piping layouts are included.

86 HOT WATER BOILERS

Combustion Engineering, Inc.—20-page brochure describes and illustrates the design, construction, advantages, and economies of the La Mont controlled circulation hot water boiler for supplying high pressure, high temperature water for heating systems and process applications.

87 THREAD INSERTS

Heli-Coil Corp.—Catalog on standard line of screw thread inserts designed for protection and repair of tapped threads in all materials is contained in Bulletin 652-A. Covered are design information, drilling and tapping recommendations, and specifications for various classes of fit. Also available is Bulletin 738 which provides similar details on new screw-lock insert which eliminates the need for lock washers, lock nuts.

88 GAGES AND THERMOMETERS

Marsh Instrument Co.—Catalogs No. 76-G and 76-T describe in detail a wide line of industrial gages, needle valves, and thermometers. The catalogs are fully illustrated, including cut-away photographs and enlargements of internal parts. They cover also gage accessories, specifications including line drawings and dimensional tables, and templates covering every size and pattern.

89 VALVE CONVERSION UNIT

C. H. Wheeler Mfg. Co.—A new automatic valve actuating conversion unit is described in Catalog V-200. It is called Valvmatic and converts hand-operated valves to motor operation without removing the valve from line or disturbing piping. It is actuated electrically, and will open and close windows and operate valves.

90 FIRE PUMPS, FITTINGS

Peerless Pump Div., Food Machinery & Chemical Corp.—A 32-page bulletin, No. B-1500, describes, illustrates, and tabulates, with dimensional data, hundreds of models of Underwriters approved horizontal and vertical centrifugal fire pumps, fittings, and drivers for application to commercial and industrial risks. Addendum includes selection charts with data for each model.

91 SERVICE PUMPS

Layne & Bowler, Inc.—Bulletin 300 shows applications of the short-coupled vertical turbine pump with cut-away of the bowl section.

92 NUCLEAR FORGINGS

U. S. Steel Corp.—Six-page folder describes and pictures such forgings as rings, disks, closure heads, and vessel flanges, available for use in nuclear reactor construction.

93 REPRODUCTION MATERIALS

Eastman Kodak Co.—All materials available for reproduction of drawings and documents described in a booklet. A selection chart which matches originals to be reproduced with the recommended materials is included.

YOUR *New Catalogs* GUIDE

94 STEAM TRAPS

Armstrong Machine Wks.—An enlarged 48-page manual and steam trap catalog includes open float and thermostatic traps, pipe strainers to 6 in. in steel and semi steel, useful steam pipe sizing tables. Fundamentals of good trapping, trap selection, installation, testing, trouble-shooting, and repair are discussed.

95 INSPECTION INDICATING GAGES

O-Vee Gauge Co.—Bulletin illustrates and describes new line of heavy rugged indicator gages with lever type amplification which provides greater reliability. Provision is made to enable gaging fixtures and stages to be made at low cost. Examples are illustrated in the bulletin.

96 WELDMENTS

Lincoln Electric Co.—A continuing series of studies in brochure form presents ideas on efficient use of steel in machinery weldments. Presented are case histories, design short cuts, solutions to problems of rigidity, vibration, manufacturing.

97 HYDRAULIC FLUID

Shell Oil Corp.—A technical bulletin covers Irus fluid 902, a fire-resistant fluid for hydraulic applications. Information is given on safety and tests, operating advantages of the fluid, preparation and maintenance of hydraulic systems.

98 OIL/GAS BURNERS

Wickes Boiler Co.—Bulletin 58-1 provides information on oil/gas burners for shop-assembled and field erected boilers suitable for automatic combustion and safety controls. Single or multiple burner arrangements are shown. The burners are of steam, or air atomizing type for oil, center ring type for gas.

99 VARIABLE SPEED DRIVE

Cleveland Worm & Gear Co.—The firm's speed variator, a precision mechanical variable speed drive of 9 : 1 total range of ratio, is described in an eight-page, illustrated booklet designated K-200. The brochure provides product description and engineering information, including sectional views, dimensions, capacity ratings.

100 HEAT AND POWER REFRACTORIES

Norton Co.—Thirty-two page brochure compiled for the benefit of boiler operator, setters, and engineers—to aid them in solving refractory problems and to help them obtain greater efficiency from their boilers. Also included is a temperature conversion chart, "Crystolon" brick specification tables and a quick-figuring efficiency chart for boilers.

101 FLOW TUBE METERS

Ellison Draft Gage Co.—Bulletin 219 describes the company's new flow tube meters and accessory orifice flanges and orifice plates, for measuring the flow of air, gas, steam, and water, oil, or other liquids.

102 AIR SUPPLY LINE ACCESSORIES

Lincoln Engrg. Co.—A 16-page catalog describes a new line of air supply line accessories, including sockets, plugs, fittings, hose clamps, and tools.

103 MECHANICAL DRIVE STEAM TURBINE

Murray Iron Works Co.—Six-page brochure describes Type "U" steam turbine for use in industrial plants, and various special applications. The unique design affords horizontally split case above shaft centerline thus providing greater nozzle capacity.

104 INSTRUMENT BALL BEARINGS

New Departure Div., General Motors Corp.—A 36-page booklet illustrates and describes ball bearings for use in precision instruments. Tables, charts, and diagrams show the various series of miniature bearings in a wide range of applications.

105 STEEL SMOKE STACKS

Koven Fabricators, Inc.—Bulletin gives size, capacity, and engineering information on steel smoke stacks. A formula for figuring anchor bolts for self-supporting stacks and a formula for figuring guy wire for guyed stacks are included. A table also covers the effects of force of wind on stacks.

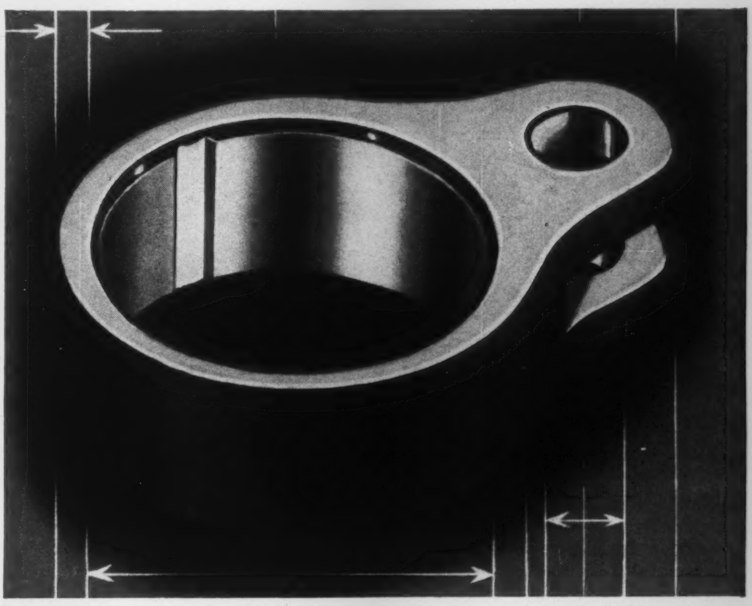
exceptionally close limits...

The photograph shows the connecting rod of an unusual hydraulic pump built by a company whose name is known everywhere.

The finish in the bore of both the large hole and the small hole must be held to very fine profilometer reading.

In addition, the axes of these two holes must be parallel to each other within exceptionally close limits. Naturally, the user of a cast bronze part such as this turns to Bunting in order to assure strictest adherence to his print and specifications.

For the unusual, as well as the usual, in bearings, bushings, bars, or special parts of cast bronze, sintered bronze, or Alcoa aluminum, try Bunting first.



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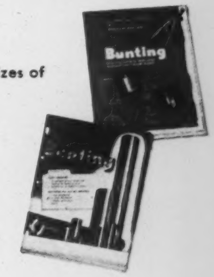
Bunting's "Engineering Handbook on Powder Metallurgy" and Catalog No. 58 listing 2227 sizes of completely finished cast bronze and sintered oil-filled bronze bearings available from stock.



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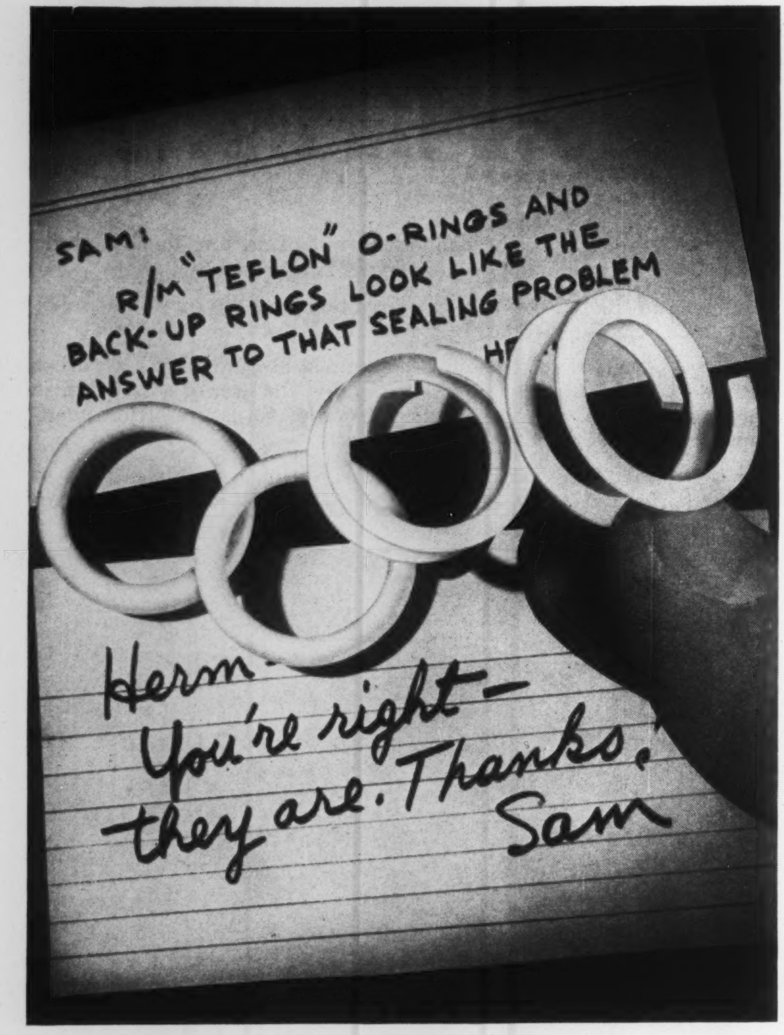

"Teflon"* O-Rings and back-up rings, precision machined by R/M, give you a reliable solution to many difficult sealing problems. Top-quality production techniques provide accurate fit and consistent performance.

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YOUR *New Catalogs* GUIDE

106 PRESSURE GAGES

American Chain & Cable Co., Helicoid Gage Div.—The 24-page Helicoid gage catalog describes the Helicoid gage as guaranteed accurate to within $^{1}/_{2}$ of 1 per cent of the total dial graduation over the upper 95 per cent of the 270-deg dial arc. Cutaway photographs and line drawings show the complete line of Helicoid gages.

107 AIR, HYDRAULIC CYLINDERS

Anker-Holth Div., Wellman Engineering Co.—Brochure AD-3 describes and illustrates standard air and hydraulic cylinders and valves, including five types of air cylinders, four types of hydraulic cylinders, also rotating air and hydraulic cylinders.

108 CARBON STEELS

Bethlehem Steel Co.—Booklet 366 discusses the general characteristics of the major grades and types of steel bars in order to help guide the user in selecting the correct steel for his particular purpose.

109 INSTRUMENTS, SYSTEMS

Gulton Industries, Inc.—Four-page facilities brochure covers the firm's instruments and divisions in the field of electronics, electricity, ceramics, telemetry, and other devices for use as single components or complete systems.

110 INDUSTRIAL TURBINE PUMPS

Fairbanks, Morse & Co.—Bulletin APB 235.33 illustrates features and application of vertical turbine, inverted turbine, pot type, and submersible pumps. Exclusive and optional features, sizes, and capacities are listed.

111 LUBRICATION EQUIPMENT

Oil-Rite Corp.—Catalog No. 10 describes lubricating equipment from plain oil cups to completely automatic systems. Applications of this equipment in the supplementary reports show how it is used to reduce maintenance and lubricant costs and prolong the life of production machinery.

112 FILTERS

Air-Maze Corp.—General catalog describes entire line of air filters and liquid filters, including oil bath air filters for engines, compressors, blowers, heating and ventilating filters and electrostatic precipitators, all metal, cleanable liquid strainers offering down to 10 μ filtration, intak silencers, exhaust spark arresters.

113 CUSTOM GEARS

Cincinnati Gear Co.—Illustrated folder describes and shows examples of types of gears produced to individual specifications only for all types of machinery and products. Gear types listed include spur, helical, rack, worm, herringbone, bevel, spiral bevel, internal, sprocket, Zerol (R) bevel and Coniflex (R) bevel; also custom gear boxes.

114 O-RINGS

Linear Inc.—Compact 20-page folder contains tables of standard O-ring sizes as well as dimensional data for installation. Notes contain general recommendations on clearances, design material, machining, and finishes for most O-ring applications. A special compound bulletin describing the latest polymers and synthetic rubbers from which O-rings can be molded is also Included.

115 WATER CONDITIONING

Permutit Co. Div., Pfaudler Permutit Inc.—A 12-page bulletin, No. 4433, is a general discussion of the major types of water treating equipment—filters, zeolite softeners, precipitators, chemical feeders, demineralizers. Each equipment type is illustrated and discussed briefly. Water impurities and then general methods of removal are tabulated and typical water treatment systems for municipalities, utilites, and industries are illustrated.

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116 OIL AND GAS BURNERS

Ray Burner Co.—A new illustrated 16-page catalog gives specifications and capacities of commercial and industrial gas, oil, and combination gas-oil burners. It covers fully automatic, semi-automatic, and manually controlled horizontal rotary oil burners, gas burners, and combination gas-oil burners; commercial and domestic pressure-atomizing types for oil, gas, or combination gas-oil inshot gas burners; forced draft packaged burners. Tables and other technical data.

117 BALL BEARINGS

New Departure Div., General Motors Corp.—Dimensions, load ratings, and mounting fits are detailed in the 24th edition of the company's ball bearing catalog. The 158-page book contains tables, drawings, and extensive selection data and specifications.

118 BOILERS, STOKERS

Bituminous Coal Institute.—A 78-page guide specifications brochure provides design criteria on ram-type underfeed stoker-fired steam plants that have loads of 10,000 to 40,000 lb per hr. The material covers boilers, stokers, ash handling, etc. Three illustrations are included; two are boiler room layouts and the third shows details of appurtenant equipment.

119 ROTARY GAS METERS

Roots-Connersville Blower, Div. of Dresser Industries, Inc.—Bulletin M-258 lists 39 sizes of rotary type positive displacement gas meters, for measuring flows ranging from 1000 to 1,000,000 cfh at pressures up to 125 psi. Descriptive data, dimensional information and installation views are provided. Certified meter proof tests on Bureau of Standards approved equipment offered.

120 PIPING INSULATION MANUAL

American Gilsonite Co.—A 20-page booklet covers the methods of application of Gilsulate, a new insulation for hot underground pipes. It describes the three grades, how to determine ditch size for various pipes and types of soil, and gives sample problems.

121 CHEMICAL TREATMENT

Layne & Bowler, Inc.—Six-page folder illustrates and describes chemical treatment for water wells. It lists treatment materials and shows microphotos of bacteria found in wells.

122 GASKETS METAL RASCHIG RINGS

Metallo Gasket Co.—Bulletin No. 57 describes metal and metal combined with soft packing for use on high and low pressure service, metal tower packing made as Raschig and Lessig rings. Also washers, shims, and metal asbestos valve disks.

123 STRUCTURAL HANDBOOK

Aluminum Co. of America—Revised handbook supplies design information on the use of aluminum in structures. New edition has 420 pages including 140 tables.

124 DRUM STEAM GENERATORS

Erie City Iron Wks.—Catalog SB61, 16 pages, illustrates by cross section and wash drawing both open pass and multi-pass 2-drum steam generators and auxiliaries. Examples of pressurized and balanced draft multi-pass installations are shown. Details of design and construction for steam separators, superheaters, economizers, air preheaters, and water walls are included.

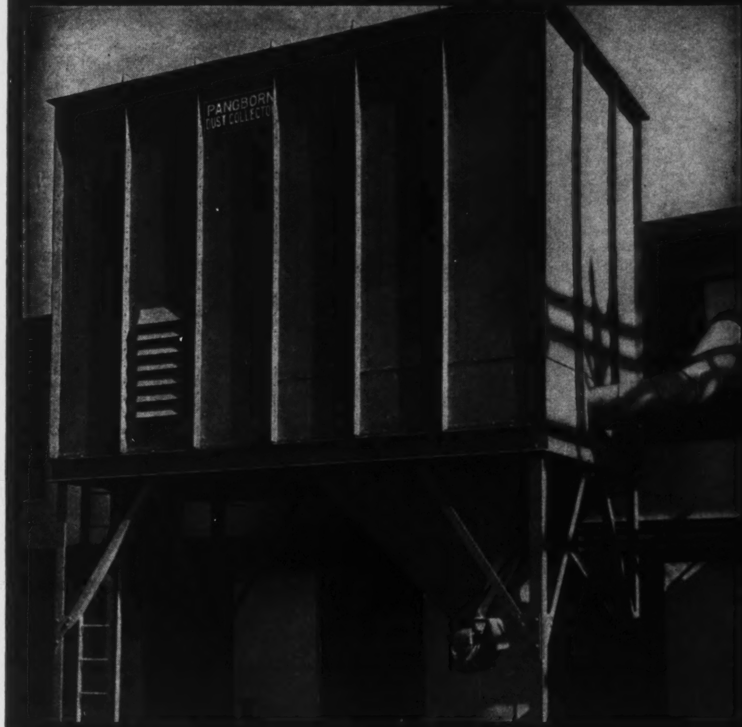
125 COATING SYSTEMS

Rust-Oleum Corp.—New 38-page catalog in four colors with 101 actual color chips features new Color Horizon system, plus heavy-duty chemical resistant, heat resistant, floor coating, speedy-dry, water resistant, and galvinoleum coating systems. It includes a special technical section on surface preparation.

126 HYDRAULIC PUMP SELECTION

Blackmer Pump Co.—A 36-page technical manual outlines procedure for making pump selections. Bulletin shows easy method of analyzing suction and discharge conditions, provides definitions of common hydraulic terms plus direct-reading tables for determining pipe friction losses. Additional tables show physical properties and pump construction for over 100 common liquids.

TRAPS ALMOST 4 CU. FT. OF DUST PER WEEK



One small Pangborn Dust Control system replaces 8 collector units profitably at Precision Rubber Products

At Precision Rubber Products Corporation, Dayton, Ohio, millions of seals pass through a buffing process every year. The resulting dust could constitute an operating and housekeeping hazard. To facilitate dust control, the company replaced eight individual collector units with a central Pangborn Dust Control system. This installation saves floor space, operates quietly and gives efficient dust control (trapping almost 4 cu. ft. of rubber dust per week). Dust is now removed from *one* collector hopper instead of eight individual hoppers.

If dust is a problem in your plant, talk to the Pangborn man in your area or write PANGBORN CORPORATION, 2200 Pangborn Blvd., Hagerstown, Md. *Manufacturers of Dust Control and Blast Cleaning Equipment—Rotoblast® Steel Shot and Grit.*

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Where strength is a factor

HOT FORMED NUTS

. . . Induction heated

Through induction heating and modern forming equipment, these Screw and Bolt nuts attain superior finish, wrenching qualities and tolerances.

The instant heating process eliminates cold working strains prevalent in conventional cold made nuts, minimizing oxidation. Then modern equipment forms these nuts to geometric perfection and exceptionally close tolerances . . . for secure, snug-fitting connections.

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America's Most Complete Line of Industrial Fasteners

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LATEST
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LITERATURE

127 O-RING DATA

Federal-Mogul-Bower Bearings, Inc.—Catalog 204 gives engineering, selection, and application data on O-rings. Physical properties are detailed and a section gives sizes and cross reference. It includes a list of the firm's field offices.

128 STAINLESS STEEL

Sharon Steel Corp.—A 32-page catalog offers description, chemical composition, strength factors, physical properties and applications for stainless steels, including the 200, 300, and 400 series. Forging ingots and rolled-in surface patterned stainless steels are included.

129 BLAST CLEANING UNITS

Pangborn Corp.—Bulletin 705 describes new heavy duty Rotoblast barrels. Features and dimensions ranging from 20 to 102 cu ft capacities available for all production cleaning requirements. The Rotoblast wheel, throwing up to 60,000 lb of abrasive per hour, the abrasive reconditioning system, and other features are covered. Bulletin 706 describes standard-duty barrels and Bulletin 303A Rotoblast steel abrasions.

130 BRONZE BEARINGS

Bunting Brass & Bronze Co.—Catalog 58 lists 866 sizes of standard stock cast bronze bearings, 667 sizes of plain, flange and thrust sintered oil-filled bronze stock bearings, 267 sizes of cast bronze tubular and solid 13-in. bars, and 84 sizes of sintered oil-filled bronze 6-in. bars bearing aluminum bar stock.

131 SOLIDS—CONTACT REACTORS

Cochrane Corp.—A 24-page bulletin on solids-contact reactors contains a cut-away photograph and several pages of plan and elevation drawings showing the variety of designs available. The bulletin discusses theory and problems of cold water clarification, advantages and applications of various designs. Auxiliary and supplemental apparatus is described.

132 SYNTHETIC RUBBER

B. F. Goodrich Chemical Co., Div. of B. F. Goodrich Co.—"Everywhere in Industry—Hycar Rubber," 24 pages, describes Goodrich Hycar rubber and its properties, using text and tables. General applications and uses are suggested for the different types and blends available.

133 STAINLESS STEEL FITTINGS

Ladish Co.—An 86-page master reference volume on stainless steel pipe fittings gives information on broad line of IPS and tube OD fittings, ASA, MSS and corrosion weight flanges. Technical section includes manufacturing standards, specifications, corrosion resistance tables, and data on welding of stainless steel.

134 CHEMICAL FEEDER

B-I-F Industries, Inc., Proportioneers Div.—Design features of Model 1210 Chem-O-Feeder, are covered in Bulletin 1210.20-1. Low cost, dependable, positive displacement pump, designed for ease of installation, minimum maintenance, and elimination of air binding. Available with one, two, or three "See-thru" chemical reagent heads.

135 HEAT TREATING UNIT

Ipsen Industries, Inc.—Literature describes an automatic high vacuum cold wall type furnace with a work space 10 in. diam and 14 in. deep. Maximum operating pressure is 0.1 micron Hg; input is 25 kw. Maximum operating temperature is 2500 F. The unit is adaptable for high temperature copper or nickel brazing of stainless assemblies.

136 CENTRIFUGAL PUMPS

American-Marsh Pumps, Inc.—Six-page Bulletin 350 describes horizontal split case, single stage, double suction centrifugal pumps. Types HLM and HIM for wide range of capacity and head conditions. Large sectional view explains 18 important features. Specifications, performance data and dimension tables are included.

137 GRAPHALLOY BEARINGS

Graphite Metallizing Corp.—Catalog 4 illustrates and describes solid and split self-aligning pillow blocks and hanger bushing assemblies with Graphalloy oilless bushings. They are designed to operate dry to 700 F in air in dryers, ovens, conveyors, kilns, refuse burners.

138 MATERIALS HANDLING

Syntron Co.—A condensed catalog, No. 596, contains 68 pages of technical data, brief description and photographs of bin vibrators, vibratory feeders, vibratory conveyors, power tools, shaft seals, selenium rectifiers, vibrating parts feeders, and other equipment.

139 INDUSTRIAL COOLING FANS

Koppers Company, Inc., Metal Products Div.—A 4-page folder illustrates and describes new, all-metal, "Precision-Engineered" Aeromaster fans for cooling towers and radiator-type coolers. Design features are discussed.

140 HEAVY DUTY COMPRESSORS

Pennsylvania Pump & Compressor Co.—Single stage, horizontal, water cooled, heavy duty air compressors in sizes from 10 to 125 hp and for pressures to 150 psig covered in Bulletin 350.

141 REFUSE INCINERATOR WALLS

Bernitz Furnace Appliance Co.—Bulletin B-58 describes silicon carbide air-cooled blocks for incinerator walls. The blocks are designed to improve combustion, insure long furnace wall life, and reduce maintenance and down time.

142 OPTICAL TOOLING

Charles Bruning Co.—A 20-page illustrated booklet, explaining the theory, principles, and practice of the new technique of optical tooling. The booklet shows how optical tooling provides tolerances of .003 in. in 100 ft. It is claimed to offer easier construction, assembly, inspection, and unsurpassed dimensional control in erecting jigs, fixtures, and assembly structures.

143 MAGNETIC FLOW METERS

Foxboro Co.—Bulletin 20–14C describes two new magnetic flow meters for different flows. Developed for $^{1}/_{10}$ and $^{3}/_{16}$-in. lines, they measure full scale flow rates as low as 0.1 gpm, and are said to be useful in ratio flow control and pilot plant applications. Bulletin includes specifications and instrument data.

144 CONVEYOR BELTING

Manhattan Rubber Div., Raybestos-Manhattan Inc.—A 12-page brochure, No. M302, covers new conveyor belting. Drawings are used to describe the compensation and other features. Pages are arranged to represent an actual cross-section of the belt. It is claimed no breaker fabric is required with this belt, which means more thickness of the cover is utilized.

145 CENTRIFUGAL PUMPS

Worthington Corp.—Bulletin 2131-B1 illustrates and describes 2- and 4-stage centrifugal pumps for boiler feed and general medium pressure services in pressures to 750 psi and capacities to 2500 gpm. Cross-section and dimensional diagrams of the units are included, along with information on writing specifications.

146 AUTOMATIC PRESSURE CONTROLS

A. W. Cash Valve Mfg. Corp.—An 84-page catalog offers information on relief valves, safety devices, pressure regulators, hydronic heating valves, refrigeration controls, and protective equipment. The catalog contains capacity and spring range charts, installation, and engineering information.

147 REFRACTORIES

Carborundum Co.—Bi-monthly bulletins about refractories, their properties, uses and recent developments, are available. Subjects covered include muffled constructions, brickwork construction, research and development, a new silicon carbide refractory, wear resistance refractories, hot strength, heat resistance of refractories, thermal-shock resistance, chemical resistance, and stability.

YOUR

New Catalogs

GUIDE

148 TUBE EXPANDERS

Gustav Wiedeke Co.—Catalog 81 contains specifications on the firm's line of tube expanders and cutters. Included are tables of sizes, ordering information and a list of domestic and foreign distributor locations.

149 DIESEL, DUAFUEL ENGINES

Nordberg Mfg. Co.—A 16-page bulletin describes two-cycle, 21-in. bore, diesel, and Duafuel engines for stationary and marine service. The bulletin, No. 245, describes operating advantages of the Series 21 engine and includes views of utility, industrial power, and marine installations.

150 LIQUID CHILLERS

Frick Co.—Packaged liquid chillers, built in sizes from 20 to 180 tons of refrigeration and suitable for chilling water, brine, and other liquids to temperatures far below zero if required, are described in Bulletins 802 and 804.

151 ELEVATED STEEL TANKS

Pittsburgh-Des Moines Steel Co.—Illustrated catalog on modern water storage contains information on dimensions and capacities of various types of elevated tanks: double ellipsoidal, obloidal, tripod sphere, pedestal sphere, radial cone, and hemispherical bottom. It also shows cutaway section of an elevated tank, illustrating construction details and accessories.

152 BOILERS, BURNERS

American-Standard Industrial Div.—Loose-leaf binder with separate sheets for each series of Kewanee boilers and boiler-burner package units available includes cutaway drawings, descriptions, specification data and dimensions, and sample specifications. Residential, firebox, and scotch-type boilers are covered, ranging to 651 hp.

153 CHAINS, SPROCKETS

Diamond Chain Co.—Catalog No. 759 covers the firm's standard products and gives specific engineering data on chain selection, horse power ratings, chain and sprocket recommendation sizes.

154 FLEXIBLE COUPLINGS

Poole Foundry & Machine Co.—A 136-page manual illustrates, describes and gives engineering specification and lubrication data on flexible couplings.

155 UNDERFEED STOKER

Detroit Stoker Co.—Catalog No. 401 describes the double retort underfeed side cleaning stoker suitable for boilers to approximately 34,000 lb of steam per hour capacity. They are available with automatic controls for coal feed and air supply. Typical installation is shown.

156 STRAIN GAGES

Electronics & Instrumentation Div. Baldwin-Lima-Hamilton Corp.—Catalog covers 250 types of bonded filament resistance strain gages. Electrical and physical specifications of each gage type are included, together with prices and quantity discounts. A separate section provides data on the selection of gages.

157 BALL THRUST BEARINGS

Gwilliam Co.—General Catalog describes, illustrates and lists standard sizes of various types of ball thrust bearings, roller thrust bearings, and journal roller bearings.

158 PRESSURE CODE CHART

Missouri Boiler & Tank Co.—A wall chart provides a quick reference guide to ASME Boiler and Pressure Vessel Code (Section VIII). The chart illustrates some of the types of pressure vessel construction provided for under Section VIII, and furnishes direct references to the Code rules that apply.

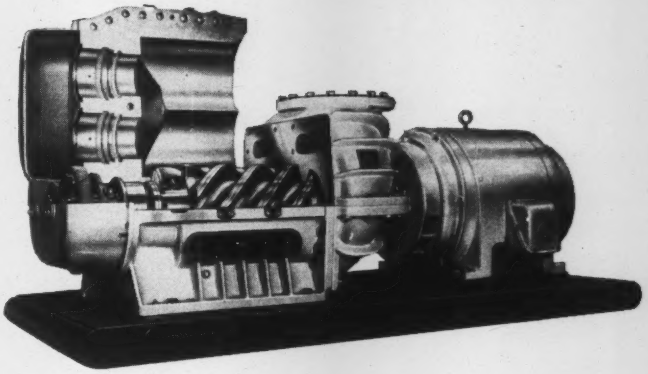
159 MATERIAL DISTRIBUTION

Carrier Conveyor Corp.—Bulletin 581 describes how natural frequency conveyors can distribute single or multiple material on a single conveyor to several screens, crushers, mills, extruders, bins, either alternately or simultaneously.

You'll find this is

the only rotary compressor

with all these features!



Fairbanks-Morse Positive Displacement Axial-Flow Rotary Compressors are available in standard models in single-stage units, with capacities from 800 to 12,500 cfm. at compression ratios from 1.6:1 to 5.0:1—or in two-stage units with capacities from 2,000 to 12,500 cfm. at compression ratios above 5.0:1—and for booster service at maximum working pressures up to 250 psig.

- **High efficiency and stability** that rivals reciprocating machines.
- **Low weight and small space** requirement that cuts costs for installation, foundation and building.
- **Oil-free output**—no metal-to-metal contact of impellers or casing, no lubrication of parts contacting gas, air or vapor.
- **Mechanical simplicity**—no valves, no pistons or reciprocating parts to wear or replace.
- **Adaptability to any power source** permits choice of induction or synchronous motor, diesel engine, gas or steam turbine as prime mover.
- **Smooth, steady operation**—impeller speed and design produce even delivery of flow with minimum pulsation or vibration.

For complete information contact your nearby Fairbanks-Morse Branch, or write Fairbanks, Morse & Co., 600 So. Michigan Ave., Chicago 5, Ill. Ask for new Bulletin ACO 100.2.

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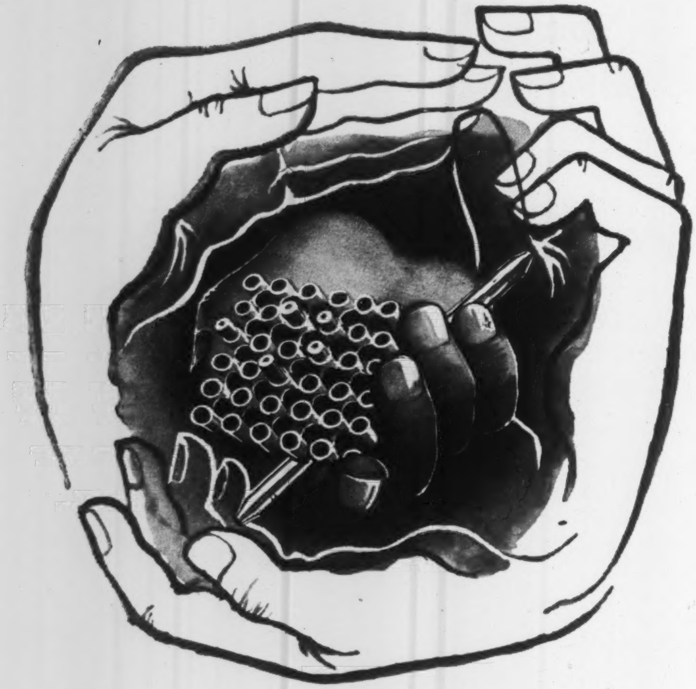
LOCOMOTIVES • ELECTRIC MOTORS • GENERATORS • MAGNETOS • HOME WATER SYSTEMS



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To generate, to control, to convert atomic fission to usable power is the result of many skills, many talents . . .

The application of advanced engineering concepts to the problems of reactor design and development, to control rod fabrication, to the thermodynamic environment within the reactor and the steam generating system requires the highest kind of mechanical engineering knowledge—requires men of unlimited ability, of unlimited imagination.

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ASSOCIATE ENGINEER with one to three years experience and a BSME or MSME degree. Will assist in the mechanical design and analysis of reactor core components such as fuel assemblies, control rods and core support structures.

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YOUR New Catalogs GUIDE

160 TIMERS, COUNTERS

Eagle Signal Co., Div. of Gamewell Co.—Bulletin 10 illustrates and describes single cycle reset timers, manual timers, time delay relays, repeat cycle timers, preset counters, step switches, and hermetically sealed timers designed to military specifications.

161 UNIT HEATERS

Grinnell Co.—Bulletin UH858 illustrates and describes gas-fired, steam, and hot water unit heaters. Sound classifications are supplied for all models and capacities with recommendations for locations, unit selection, and installation. Advantages of double coil, single coil, velocity nozzles and vertical delivery units are explained for steam or hot water.

162 AXIAL FLOW PUMPS

Allis-Chalmers Mfg. Co., Hydraulic Div.—Axial flow pumps of adjustable and fixed blade types are described in Bulletin 02B9229. They are applicable for heads ranging from 5 to 55 ft. and have been built in sizes from 11 to 150 in. in diameter with discharges from 3000 to 900,000 gpm. Bulletin incluuds typical settings, preliminary sizing data, specifications, and pump-turbine application.

163 FIRE-RESISTANT FLUIDS

Shell Oil Co.—A technical bulletin gives detailed information on synthetic fire-resistant hydraulic fluids. Data covers applications, operating advantages, procedures for changing systems and packings, gaskets, paints, and seals.

164 PRESSURE TRANSDUCERS

Pace Engineering Co.—Four-page catalog describes a line of magnetic reluctance pressure transducers and includes detailed performance specifications. Typical associated equipment and recording systems are described.

165 OIL-RETAINING BEARINGS

Bound Brook Oil-Less Bearing Co.—More than 600 of the most widely used sizes of oil-retaining porous bronze bearings are listed in the firm's Stock List No. 4. Also provided is condensed information on application, installation, lubrication and machining.

166 DRAFTING ROOM EQUIPMENT

Hamilton Mfg. Co.—Catalog No. 15 lists steel and wood drawing tables and files for every drafting room need. It includes comprehensive data on the Auto-Shift drafting table, information about the "L" table and shallow-drawer unit with tracing lifter, new Hamilton-Pack interlock files.

167 AMMONIA ABSORPTION REFRIGERATION

Black, Sivalls & Bryson, Inc.—Bulletin 33-10 illustrates and describes the firm's ammonia absorption refrigeration unit, an automatic system for the production of low temperatures for natural gas conditioning. The seven-page booklet contains specifications and diagrams. Eleven standard units are offered.

168 VIBRATING EQUIPMENT

Carrier Conveyor Corp.—Bulletin 582 describes uses of natural frequency vibrating equipment in the production of polyethylene pellets, the compounding of plastic cubes, and the processing of plastic powder or flakes. Operations illustrated are conveying, feeding, dewatering, drying, cooling, heating, screening, distributing, scalping, coating, and elevating.

169 CARBIDE BLANKS, TOOLS

Allegheny Ludlum Steel Corp.—New 32-page catalog covers information and prices on Carmet unground blanks, brazed tools, and indexable inserts. Additions to the company's standard product line are included in the catalog.

170 WATER COOLED CLUTCHES

Vickers Inc. Electric Products Div.—Bulletin 6126-3 describes new water-cooled Magneclutches designed for application requiring a high degree of slippage, as in tension control and cycling. Included are specifications, illustrations, description of the two basic bored-rotor and hollow-rotor types. Application data includes outline dimensions showing use as a clutch and use as a brake.

YOUR *New Catalogs* GUIDE

171 TRANSMISSION BELT

Manhattan Rubber Div., Raybestos-Manhattan, Inc.—Literature covers the new Poly-V "J" belt, especially designed for high-speed, small-pulley power transmission applications. It will operate over sheaves as small as 0.8 in. pd. Pitch lengths range from 8 to 98 in.

172 · REDUCERS, GEARMOTORS

D. O. James Gear Mfg. Co.—Four catalogs illustrate and describe the firm's gear-motors and speed reducers. Catalog 40-E-continuous-tooth herringbone gear speed reducers; 46-F-right angle gearmotors and motoreducers; 47-PE-planetary in-line reducers; 47-ME-in-line gearmotors and reducers.

173 ALUMINUM BEARINGS

Aluminum Co. of America.—Data is provided in two sections: first gives engineering data for the design and application of solid aluminum bearings and bushings (38 pages); second gives test data recorded from accurate laboratory and field tests of aluminum bearings (53 pages).

174 INDUSTRIAL ARTS

Eastman Kodak Co.—Fifteen-page booklet lists and describes the firm's books and guides including those in the industrial and graphic arts fields.

175 GAS TURBINE ENGINES

Solar Aircraft Co.—How gas turbine engines work, how they are used, and new developments in technology are covered in a 24-page booklet. Included are cross-section views, dimensional drawings, performance data and technical information on line of compact, lightweight engines ranging from 50 to 1250 hp.

176 FLEXIBLE COUPLING

United States Rubber Co., Mechanical Goods Div.—PowerGrip flexible coupling is described in a four-page illustrated catalog with complete selection data. Coupling consists of a reinforced neoprene sleeve, with molded internal teeth that mate with the grooves in two end-fittings, for loads to 40 hp at 1750 rpm.

177 BLENDERS

Posey Iron Wks., Inc.—Bulletin No. 60 covers Tri-Rib blenders for blending and mixing dry presized ingredients or for limited applications which involve mixing dry solids and a liquid. They are adapted for mixing anti-biotics, chemicals, detergents, greases, insulating materials, pharmaceuticals, resins.

178 BOILER, TANK CONTROL

Commercial Shearing & Stamping Co.—Three catalogs are offered. Catalog P-2 covers products for boiler and tank manufacture; 200-Cl, standard metal shapes available without tool and die charge; 900-P5, stampings, forgings, rotoforms.

179 EXPANSION JOINTS

Zallea Brothers—A 72-page catalog contains technical data, illustrations and information covering the company's eleven basic types of expansion joints. Tables, charts, and drawings give engineering specifications. Selection chart tells how to choose the correct expansion joint.

180 AIR-HYDRAULIC ACTUATOR

Electro-Mechano Co.—Bulletin describes hydraulic controlled air cylinder used for actuating many mechanical movements. The unit has a unique built-in valve arrangement which allows two different traverse rates throughout stroke. Cams can be set to determine points of rate change.

181 PRECISION BORING

American Hollow Boring Co.—Sixteen-page brochure illustrates the firm's equipment, facilities, and operations in boring holes to specifications and precision testing. Data on hollow bored cylinders included.

182 MOTORS, COMPRESSORS

Gast Mfg. Co.—Twelve-page booklet contains 43 photographs, case histories of current original equipment applications of air motors, compres-

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to seal
any shaft!

Name your most difficult shaft sealing problem, and you've named the best reason for using a Borg-Warner Mechanical Seal on that shaft.

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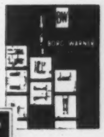

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Severe Service is possible only through specialized equipment and highly practiced skills—the same as lie behind the quality of every ROCKFORD CLUTCH. Each order is given the extra measure of care that makes ROCKFORD CLUTCH quality a byword in industry. Due to rigidly held specifications covering the chemical analysis of materials, and properly governed heat treatment, the pressure plates used in ROCKFORD CLUTCHES withstand the most Severe Service. The plates are made from superior quality materials of more than adequate tensile strength. Heat treatment further improves the grain-structure and strength of the iron. We urge your engineers to consider this and other advantages of ROCKFORD CLUTCHES—when designing your next application of a clutch.

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Automotive Spring Loaded
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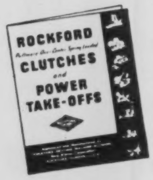
Oil or Dry Multiple Disc
Heavy Duty Over Center
Light Over Center
Power Take-Offs
Speed Reducers



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CLUTCHES

YOUR *New Catalogs* GUIDE

sors, vacuum pumps. Diagrams illustrate the pneumatic principles used on industrial machines and business and laboratory equipment.

183 WORM GEAR JACKS

Duff-Norton Co.—Eight-page bulletin, No. AD-66, describes how two or more jacks can be tied together in a jacking arrangement by means of couplings, shafting, and mitre gears boxes. All jacks will raise and lower in unison and arrangements can be motor driven. Jack capacities range from two to one hundred tons. Specifications and dimensions drawings are included.

184 FRICTION MATERIALS

Johns-Manville—A 16-page brochure, FM-35A, gives descriptions, design data, characteristics, and a reference chart of industrial friction materials including asbestos brake blocks, linings, and clutch facings.

185 X-RAY GAGE

Sheffield Corp.—The Measuray, a non-contact X-ray gage for measuring the thickness of metals or nonmetals in strip or sheet while in motion or stationary, is described in Catalog No. AU-113-57. Materials checked include hot or cold strip steel, brass, copper, aluminum, plastics, foils, coated fabrics, films, rubber.

186 HOSE, FITTINGS

Flexonics Corp.—Catalog describes metal and synthetic hose and fittings, with data tables, information on computing hose length, installation instructions, hose construction, etc. Interlocked and corrugated metal hose, low to high pressure synthetic hose with re-usable and permanent fittings, and Teflon hose and fittings are included.

187 OPTICAL INSTRUMENTS

Bausch & Lomb Optical Co.—A booklet, "Industrial Optical Aids," contains information on an assortment of inexpensive precision optical instruments and suggests ways to use them to gain faster, easier, lower-cost production. Items discussed include magnifiers, microscopes, wide field tubes macroscopes and comparators. Catalog D 1059.

188 METAL CONSTRUCTION

Pittsburgh-Des Moines Steel Co.—A 36-page general brochure describes the capabilities and diversities of engineering, research, fabrication and construction of steel, stainless steel, stainless clad steel, alloy, and aluminum.

189 VALVES, CONTROLS

Hays Mfg. Co.—A packet of data sheets covers the firm's lines of solenoid valves, controls, strainers and automatic interlocks. Specifications, dimensions and flow charts are given.

190 LEAD PENCILS

Eberhard Faber Pencil Co.—Four-color catalog sheet describes and illustrates new, improved Microtomic drawing pencils. It also features Race Kleen, Pink Pearl, and Rubkleen erasers, describing their uses by artists, draftsmen, and architects.

191 SPECIALTY STEELS

Crucible Steel Co. of America—Catalog lists descriptions of literature, technical aids and data sheets published by the firm in the field of utilization of specialty steel products.

192 WORM GEARING

Cone-Drive Gears Div., Michigan Tool Co.—Literature covers double-enveloping worm gearing supplied in standardized gear sets of 9 ratios on 15 different center distances from 2–24 in. available as gear sets and in complete speed reducers. The same ratios are supplied in 8-center distances in gearmotors. All sizes of gearmotors and standard speed reducers from 2–3½ in. are available with hollow shafts.

193 SPREADER STOKERS

Erie City Iron Wks.—Catalog SB62 describes dumping grate spreader and the Travagrate (continuous ash discharge) spreader stokers. Coal feed and control for both types are illustrated. The hydraulic Travagrate drive unit is shown in phantom view. Typical applications are included.

YOUR *New Catalogs* GUIDE

194 SUBMERSIBLE PUMPS

Layne & Bowler, Inc.—Bulletin 202 describes applications for deep well submersible pumps with a detailed cut-away of the pump.

195 COPPER, COPPER ALLOYS

American Brass Co.—A 32-page reference booklet on corrosion resistance of copper and copper alloys covers continuous laboratory research and field study of the nature of corrosive attack on these metals conducted for a period of 31 years by the company's technical staff. Latest findings are incorporated in the text of Part I, "Theory of Corrosion and Types of Corrosive Attack."

196 SPRING PINS

C. E. M. Co.—Catalog lists prices, dimensions, technical information on heavy, medium, and light duty Spirol spring pins in carbon steel, chrome stainless steel, and nickel stainless steel. Typical applications are illustrated.

197 DIAPHRAGM VALVES

Grinnell Co.—An 8-page catalog describes diaphragm valves offering streamlined fluid passage, flow control, leak-tight closure. Isolation of working parts from fluid stream is said to prevent product contamination and corrosion of operating mechanism. Flexibility of assembly and wide choice of materials for bodies, body linings and diaphragms are described.

198 ADJUSTABLE STORAGE RACKS

Sturdi-Bilt Div., Union Asbestos & Rubber Co.—Sixteen-page catalog shows how storage racks systematize storage of pallets, dies, drums, skids. It illustrates the system by which prefabricated components are assembled (or disassembled) without tools, welding, nuts, bolts, or special labor. Catalog includes technical data including sizes, specifications, loads, applications.

199 DEAERATION

Cochrane Corp.—Publication No. 4650 explains in capsule form the fundamentals of deaeration and why it is necessary in water conditioning. The principles of operation as well as the advantages and application of the various methods of deaeration are discussed.

200 MIDGET STEAM GENERATOR

Pan-Tex Mfg. Corp.—Bulletin, SG-200, describes the company's Series R model electrode principle steam generator and steam-jet cleaner. The unit is described as the first midget size boiler for high pressure steam up to 250 psig and temperatures up to 405 F.

201 STOCK, BUSINESS CHARTS

Traders Research, Inc.—Catalog lists books and charts dealing with stocks, transactions, analyses.

202 SWIVEL JOINTS

Chiksan Co.—Bulletin 1258A describes new line of DM and DS series swivel joints featuring interchangeability of packing for multiple services, in malleable iron for low pressures, steel for pressures to 1000 psi. They are recommended for chemicals from −40 to 400F (300 psi at 400 F), steam and hot gas. Bulletin gives packing information, lists dimensions, charts pressure-temperature relationship.

203 CONTROLS, INSTRUMENTS

Fischer & Porter Co.—A 54-page catalog describes the company's products including indicating, recording, controlling, and transmitting instruments for flow, pressure, temperature, density, viscosity, and consistency.

204 BUCKET ELEVATORS

Jeffrey Mfg. Co.—Catalog 950, 96 pages, covers all aspects of materials-handling elevator equipment. It introduces special cement mill elevator, and contains drawings, diagrams, specification charts, installation photographs.

205 SUPER REFRACTORIES

Carborundum Co., Refractories Div.—"Properties of Super Refractories," twenty-four pages, covers latest data on super refractories including newly developed compositions for specialized applications. Re-frax silicon-nitride bonded silicon

NEW! Monoflange valve is guaranteed drop-tight at 150#

The Henry Pratt Monoflange MK II is a top quality butterfly valve that fits between the pipe flanges of a fluid or gas line. **It saves weight, space and labor** because it eliminates a pair of flanges and requires only one bolting operation. **It eliminates gaskets** because the faces as well as the inside of the valve body are covered with rubber permanently bonded to the metal.

Low torque makes the Monoflange easy to operate, especially with Henry Pratt's **new SIDEWINDER manual operator.** Any type of power operator can be used if desired. Structural features include streamlined disc, one piece shaft, chevron packing and Nylon bearings. Various materials available for corrosive liquids.

Standardized and mass produced, this new valve offers famous Henry Pratt quality at a new low price . . . you can't find a similar valve that offers so much in quality or performance.

Complete information available. Water and gas flow data, valve sizing, operator selection in 26 page brochure. An ideal tool for the engineer working with and specifying valves. Write for Bulletin 10 EH.

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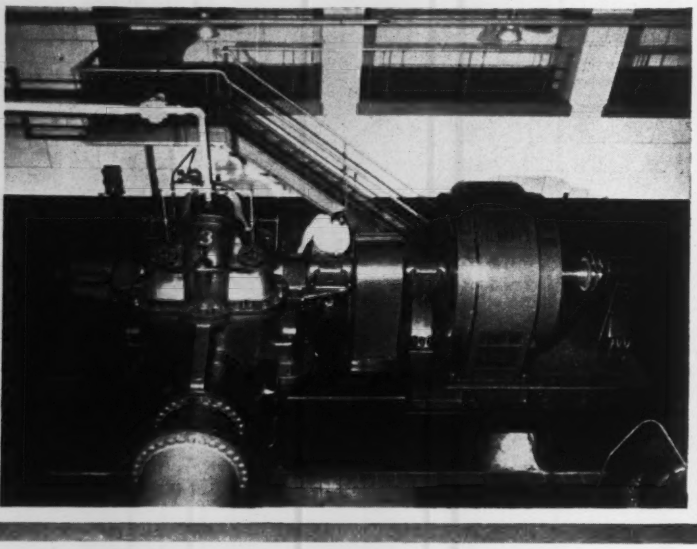

Typical installation in Toledo averages 80.314% wire-to-water efficiency for year!

Exceptionally high and dependable efficiency with steady, low-cost operation year after year—that's the report from a host of municipalities and industries using Fairbanks-Morse pumps in their pumping stations.

Why? Ask stations like Collins Park High Service in Toledo, O., where five Fairbanks-Morse 36-in. Split-Case Centrifugal Pumps have been giving superb performance for 17 years. The No. 3 pump in the photo pumped 6,065,590,000 gallons in one year alone, handling 26.13 percent of the plant total, and consuming just 3.55 kilowatts hours per million foot gallons!

Your Fairbanks-Morse Field Engineer welcomes you to inspect many other reports like this from his files—reports revealing why no other manufacturer can match the experience of Fairbanks-Morse in providing pumps and drivers for both municipality and industry. Your F-M Field Engineer will be glad to work with your own engineers in selecting the best equipment for your specific requirements. Write Fairbanks, Morse & Co., 600 S. Michigan Ave., Chicago 5, Ill.

See Sweet's Product Design Catalog File for complete F-M Pump Line.

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LOCOMOTIVES • COMPRESSORS • GENERATORS • MAGNETOS • HOME WATER SYSTEMS

carbide refractories which can be produced in intricately designed shapes to close dimensional tolerances is described. Chemical analysis and physical property charts are provided on all materials.

206 CENTRIFUGAL FANS

Ilg Electric Ventilating Co.—Type BC centrifugal fans with airfoil blades, aluminum sides and scroll, in both direct-connected and belted models for ventilating and heating equipment are illustrated and described in eight-page Bulletin S317. Performance, dimensions and capacities are given for each type with detailed drawings.

207 O-RINGS

National Seal Div., Federal-Mogul-Bower Bearings, Inc.—This National O-ring catalog is designed for broadest usefulness in ally types of O-ring applications. Includes practical working information about O-ring applications, sizes, groove dimensions, back-up rings, and dust seals, and lists all National O-rings and local National Seal Division offices.

208 PUNCHES AND DIES

T. H. Lewthwaite Machine Co.—Catalog sheets illustrate and describe hand operated punches. cutters, and benders and list large, planned stock of punches and dies to fit most makes of punch presses. New, simplified system of decimal die marking is introduced with charts for determining correct clearance to allow for both type and thickness of metal being punched.

209 AUTOMATIC CONTROLS

Mercoid Corp.—Catalog No. 860, a 64-page reference book for engineers, contains information on automatic controls for pressure, temperature, liquid level, and mechanical movement. Transformer-relays and mercury switches.

210 GENERATORS, BOILERS

Wickes Boiler Co.—Bulletin 55-1 gives information on the facilities and products of the company including drawings of typical steam generators and shop-assembled water tube boilers. Units shown from 15,000 lb capacity of steam per hour to 300,000, designed to operate to 1000 psi. Duotherm vaporizers, economizers. superheaters, and airheaters are included.

211 PORTABLE TESTER

Hunter Spring Co.—Bulletin 750e describes a new portable tester originally developed for testing the mechanical strength of solderless electrical terminals but suitable for other tensile testing. It is available in seven models for ranges from 0-20 up to 0-500 lb.

212 ALUMINUM, MAGNESIUM CASTINGS

American Brake Shoe Co.—Brochure shows how precision, high-strength castings in light alloys can reduce weight, improve design, and cut costs in critical airborne components. Listed are mechanical properties guaranteed in castings of aluminum and magnesium alloys; government specifications for casting and inspection methods.

213 LAMINATED PLASTICS

Formica Corp.—A condensed catalog of technical information describes services and product areas of the company's industrial products section. Included is information on Copperclad laminates, laminate sheet sizes, moldings, rods, tubes post-forming, and special NEMA and special grade charts and a comparator chart.

214 SMALL DIESEL ENGINES

Fairbanks, Morse & Co.—Bulletin AOB 380.11 shows specifications and application of Model 45 engine for power units and generating sets. Size range $5^1/_4$ to 32 hp. The units are medium high speed, heavy duty.

215 VIBRATION INDUCERS

Martin Engrg. Co.—A 38-page catalog gives engineering data, specifications, and price list on the Vibrolator line of vibration inducers, listing 52 sizes and types from the BD-10 ($4^1/_2$ oz) to the 3000 lb impact CCVP series hopper car shaker (72 lb.) Units are available in pneumatic, electric, gasoline, hydraulic, and steam.

YOUR *New Catalogs* GUIDE

LATEST
INDUSTRIAL
LITERATURE

216 METAL HOSE

Atlantic Metal Hose Co.—Bulletin 500-A contains descriptions and illustrations of high pressure hose made of heavy bronze or galvanized steel strip, air jacketed hose for diesel exhaust, conveyor hose for ventilating and exhausting. Bulletin 21-A covers flexible stainless steel hose.

217 HIGH EFFICIENCY FANS

Clarage Fan Co.—A new line of high efficiency fans, incorporating an advanced airfoil backward curved blade design, is described in Catalog 859. The Dynafoil fans are designed for mechanical draft, industrial processes, conduit type air conditioning, tunnel ventilation, and other heavy-duty applications.

218 AIRCRAFT BALL BEARINGS

New Departure Div., General Motors Corp.—A 16-page booklet covers the application of ball bearings in aircraft engines and accessories. Charts show the effects of load and speed, high temperature and tables show dimensions of bearings in a variety of flight applications.

219 HUMIDIFICATION EQUIPMENT

Bahnson Co.—Catalog Section 104 details the firm's line of industrial humidification equipment. Information and pictures describe and show various types of steam and water humidification equipment. The different uses, capacity, function, and operation of each type is explained.

220 VACUUM PUMPS

Leiman Bros., Inc.—A 16-page catalog, No. 359 describes rotary positive air and vacuum pumps, gas boosters and air motors. Included are 2 and 4 wing types; fan-cooled, water-cooled and new radiator air-cooled models; motor driven units; direct-coupled and belt-driven models, integral pump and motor; automatically controlled tank units; accessories.

221 HONING EQUIPMENT

Micromatic Hone Corp.—A 32-page catalog, AR-136, explains Microhoning process, including stock removal and automatic size control. Applications, specifications, work capacities of machines for small, medium range diameters, long stroke vertical machines, horizontal machines, multiple-spindle machines are given. Also described are tools, job services, and other company aids.

222 SCREW THREAD STANDARD

O-Vee Gauge Co.—"Screw Thread Standard H.28" has been revised and reprinted and issued Sept. 1957. New gaging requirements are discussed and described in a brochure, illustrated by diagrams.

223 OIL AND GREASE

Shell Oil Co.—Technical bulletins cover Darina grease, a multi-purpose microgel grease, and Dromus Oil E, a lubricant for high-speed metal machining operations.

224 CONTROL VALVES

Conoflow Corp.—A 12-page bulletin describes construction and operation of the Series LB control valve. Features, including single-seat construction, extra thick body walls, integral or separable flanges, fully guided plug, and liftout seat ring, are covered. Operation of new Model J valve positioner is discussed.

Fill in and Mail the coupon on page 140 without delay.

225 HEAT EXCHANGERS

American-Standard Industrial Div.—Bulletin 1.1K6 describes expanded, redesigned line of standardized, pre-engineered Type BCF exchangers. New features include baffles with flanged lip at tube holes and outer edge for improved thermal characteristics; movable feet; corrosion resistant copper alloy core assembly; and cast iron bonnets. Specifications detail 46 stocked sizes in one, two and four-pass designs.

226 ROTARY CAR DUMPER

Heyl & Patterson Inc.—Literature describes a new rotary railroad car dumper. The unit is equipped with two clamps holding the car securely, not requiring counterweights. It can be dumped and returned in one minute with a 30-hp drive. Optional equipment is electronic scale in the dumper platen and power operated car retarders.

227 DIESEL, DUAFUEL ENGINES

Nordberg Mfg. Co.—Series 29, two-cycle diesel and duafuel engines for stationary and marine service are described in a 16-page bulletin, No. 235A. With 29-in. bore and 40-in. stroke these engines are claimed to be the most powerful single action, two-cycle engines built in America.

228 CLAD STEEL EQUIPMENT

Lukens Steel Co.—A 28-page booklet covers the development, manufacture and properties of clad steels, the types of cladding materials available, design considerations, fabrication techniques and clad steel equipment applications.

229 BLOWERS, EXHAUSTERS

M-D Blowers, Inc., Subsidiary of Miehle-Goss-Dexter—Six-page folder on 3-lobe rotary positive industrial blowers and exhausters covers advantages over conventional 2-lobe blowers in pressure range, size, weight, cost, and service. Operating data, capacity curves, and typical applications, including use in pneumatic conveying, are given for 24 production models.

230 ALUMINUM PIPING

Aluminum Co. of America—Eight-page booklet describes product piping with integral steam tracing (Unitrace) and the family of fittings that have been developed for it. A 26-page booklet contains information, complete with 16 pages of drawings to simplify installation of the unit.

231 SPIRAL CONVEYOR

Jeffrey Mfg. Co.—Catalog 951, 56 pages, includes engineering data, conveyor layouts, specifying information, specifications, drives, capacity tables, feeders, hangers, throughs. Charts, drawings, photographs support detailed description.

232 STEEL WIRE

American Chain & Cable Co., Page Steel & Wire Div.—A 16-page catalog, DH-1226, on Page shaped wire includes specification tables, range of sizes, physical properties of steel wire, table of standard wire gages, hardness conversion tables, with illustrations showing how to calculate areas of typical common shapes of wires. Size range includes cross-sectional area up to and including No. 3 BWG; flats and rectangles in widths up to $^3/_8$ in., the ratio of width of thickness not exceeding 6 to 1.

233 REVERSING DRIVE

Funk Mfg. Co.—A catalog illustrates and describes the firm's Reverse-O-Matic drive said to be adaptable to any equipment that has forward or backward, or up and down motion, such as road rollers or fork lift trucks. One-lever controls speed and change of direction. Standard flanges adapt it to other power transmission components, including power take-offs, right-angle drives, transmission and gear reduction.

234 REFRACTORY BRICK

Norton Co.—A 24-page booklet covers refractory brick and other fired shapes. Materials available, methods of manufacture, properties and characteristics, tables, graphs, and conversion charts are included.

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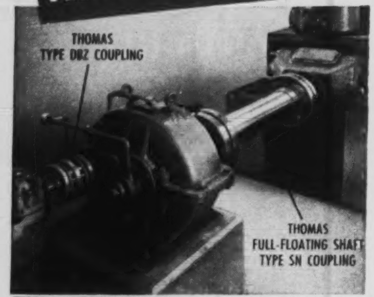

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5 Original Balance for Life
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235 COUPLINGS

Snap-Tite, Inc.—Four bulletins and various data sheets cover couplings for high pressure systems, gravity flow systems, vacuum systems, and hydraulic systems. Cutaway photos, diagrams and flow charts are included in the literature.

236 MECHANICAL-OPTICAL FACILITIES

Kollmorgen Optical Corp.—Bulletin 500 describes facilities for precision mechanical and optical manufacturing. It includes engineering and inspection equipment, plus narrative outlining company's activities in the fields of atomic energy, nuclear research and remote observation, with emphasis on industrial periscopes of which it is a prime supplier for government and commercial use.

237 STANDARD MOTORS

Sterling Electric Motors, Inc.—A 12-page colored brochure describes the firm's line of standard electric motors. The bulletin illustrates applications and contains selection information. Exclusive design advantages are described.

238 COLD STORAGE INSULATION

Zonolite Co.—Catalog details vermiculite applications for cold storage and low temperature insulation.

239 AIR OPERATED CHUCKS

Cushman Chuck Co.—Catalog No. PO-65-1957, with companion price list, describes air operated chucks, rotating air cylinders, control valves, and accessories. It also includes typical installation and advantages of air chucking.

240 MOYNO PUMPS

Robbins & Myers, Inc.—An eight-page brochure describing the history and added benefits derived from use of the Moyno pump. Phases detailed about this "progressing cavity" pump includes its principle of operation, performance, construction, capacities, and speeds.

241 RIGID PVC PIPE

B. F. Goodrich Industrial Products Co.—Bulletin 10051-A covers properties, chemical resistance, design data, specifications, and installation of Koroseal rigid vinyl piping.

242 TIMING BELT

United States Rubber Co., Mechanical Goods Div.—A set of manuals illustrate and describe, with drive tables, the PowerGrip timing belt. This drive is said to assure tooth-grip precision, and for power transmission its steel cable tension member provides horsepower that ranges from $^1/_{100}$ to 600 and up, without stretch.

243 GEAR REDUCERS, INCREASERS

Lufkin Foundry & Machine Co.—Catalog G-4 covers engineering and dimensional data on standard lines of slow and medium speed herringbone gear reducers of single and double reduction type and high speed herringbone gear units for speed reducing or speed increasing service. Engineering data on selection of size is given.

244 DRAFTING MACHINE

Universal Drafting Machine Corp.—Tracmaster, a drafting machine for large size work which features automatic board tilt, is described. The unit has beam-rails that require no initial alignment or subsequent adjustment for straightness. Engine-divided graduations on each rail divide, in effect, the drawing area into a 10-in. grid pattern.

245 COPPER DRAINAGE TUBE

Chase Brass & Copper Co.—Publication G-23, 30 pages, tells the story of the economy of copper tube and solder-joint fittings for soil, waste, and vent lines, gives roughing-in dimensions for drainage fittings.

246 PNEUMATIC TRANSMITTERS

Mason-Neilan—Bulletin No. 214 describes pneumatic transmitters for temperature and pressure applications in process control. Transmitters may be installed in any position without zero shift. Complete specifications and operational diagrams are included.

Did you know that *The Engineering Societies Library* can serve you by air mail and air parcel post? Over 170,000 engineering texts, and files of every worthwhile periodical are available for further research to meet your specific needs—patents, design, research, construction, and management problems. Charges cover only the cost of the services and represent but a fraction of the value you will receive.

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247 STRUCTURAL INSULATING PANELS

Philip Carey Mfg. Co.—Form No. 6301 provides data on a rigid, structural material that also insulates walls, roof decks, partitions. It is made by bonding asbestos-cement board to both sides of a specially processed asphalt-treated insulation board. The material is described as lightweight, water-resistant, approximately 60 per cent light reflectivity, won't rust nor rot and needs no preservative treatment or painting.

248 OIL FILTERS, STRAINERS, OILING SERVICES

Wm. W. Nugent & Co., Inc.—Seven bulletins. No. 6 illustrates and describes Nugent pressure strainers; No. 7 gravity filters; No. 7A pressure filters; No. 8 tanks, pumps, shaft oilers; No. 14 oiling and filtering systems for turbines, paper mills, steel mills, pumps, compressors; No. 15 oiling devices; No. 16 sight feed valves, multiple oilers, flow indicators, sight overflows, and compression union fittings.

249 AIR-GRAVITY CONVEYOR

Kennedy Van Saun Mfg. & Eng. Corp.—Bulletin 58-K illustrates and describes Air-Float conveyor for air-gravity conveying of dry free-flowing materials. Of principal interest to the cement, lime, and chemicals industries, the unit uses an exclusive porous plate for the conveying surface.

250 REFINERY PUMPS

Dean Brothers Pumps Inc.—Circular 201 describes new line of heavy duty centrifugal pumps for refinery and process service with top suction and discharge nozzles. Built to API and major oil company specifications, the units have capacities up to 1000 gpm. Pump sizes, mechanical design specifications, sectional view with parts list.

251 SHAFT MOTION INDICATORS

Bin-Dicator Co.—Catalog describes and illustrates Roto-Guard shaft motion indicator, a compact, low-cost unit for attachment to machines in process and other industries to give positive indication of motion, slow-down or stoppage of machinery. Can actuate signals, controls. Dimensional drawings, mounting details are included.

252 VALVES

Ledeen Mfg. Co.—A 16-page bulletin illustrates and describes the company's line of hand, foot, power and solenoid operated valves; air, oil, gas or water powered. Bulletin gives operating and flow cycles, dimensions and weights.

253 HOT WATER CONVERTERS

Patterson-Kelley Co.—Bulletin 303-A contains construction and operating data for hot water heating convertors. Tables show how to select proper convertors for such applications as industrial and domestic water heating.

254 BRAZING ALUMINUM

Aluminum Co. of America—Revised version of book presents practical shop data on brazing methods plus up-to-date information.

255 STEREO-ZOOM-MICROSCOPES

Bausch & Lomb—A catalog discusses principles and equipment used in connection with stereomicroscopy. A guide to the selection of stereomicroscopes and accessories is included. Catalog D-15.

256 HYDRAULIC HOSE

Flexonics Corp.—A 16-page catalog shows pressures and sizes of hydraulic synthetic hose. Fittings and factory crimped and field attachable types are included.

257 VALVELESS FILTER

Permutit Co. Div., Pfaudler Permutit, Inc.—Bulletin No 4351 describes the company's automatic gravity sand filter for municipal or industrial water treatment. The unit uses no valves, pumps, or flow controllers, and is said to cost less than conventional manual filters, reduce costs of installation, operation, maintenance and expansion, and produce uniform high-quality effluent. Sizes up to 400 gpm are available.

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provide long term top performance

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CAPACITIES TO 450 GPM • HEADS TO 140 FT.

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Quality is that often "HIDDEN" but ever present characteristic in AURORA pumps that provides long-term top performance. It is the sum of design features, experienced material selection, and craftsmanship.

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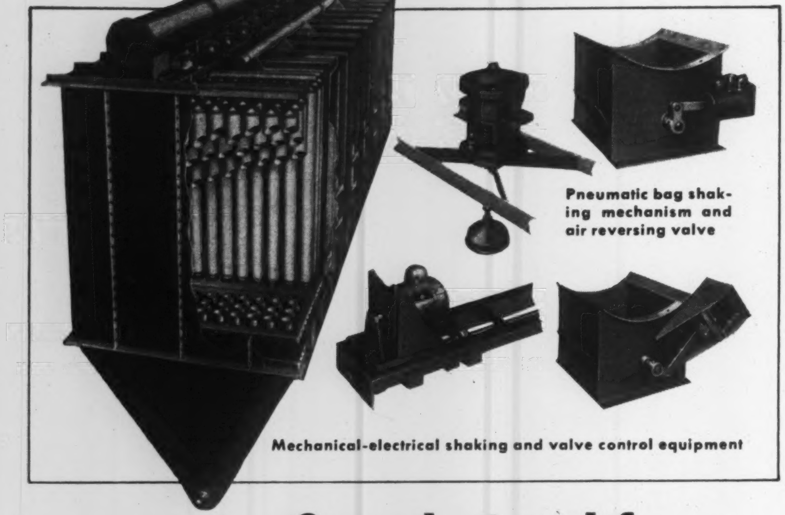
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Mechanical-electrical shaking and valve control equipment

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Whether your need is for a moderate amount of dust collection or a large scale 24 hour-a-day operation, a Norblo System will give you efficient performance at economical cost. It practically runs itself; supervision is easy — maintenance very low.

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Send a description of your air pollution problem. Let Norblo engineers suggest the best solution. Or write for Bulletin 164.

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Norblo ENGINEERED DUST COLLECTION SYSTEMS FOR ALL INDUSTRIES

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258 HYDRAULIC MULTIPRESS

Denison Engrg. Div., American Brake Shoe Co.—Catalog 120 illustrates and describes the firm's hydraulic multipress in 10 sizes from 1 to 75 tons capacity. General specifications and diagrams are included for the various models and accessories.

259 AERATORS FOR BULK STORAGE

Bin-Dicator Co.—Catalog describes and illustrates Bin-Flo, nonclogging air pads which use small volume low pressure air to restore flow characteristics to ground materials in storage. Dimensional drawings, mounting details, typical applications, wiring diagrams, list of users.

260 MECHANICAL PACKINGS, GASKETS

Raybestos-Manhattan, Inc., Packing Div.—Selected packing types designed for custom-built service on 95 per cent of all packing applications are the subject of this 40-page catalog. The book contains descriptions, illustrations, service recommendations, and specification charts that cover over 100 different products in packing and gasket materials.

261 HYDRAULIC FLUIDS

Vickers Inc.—A 24 page catalog, No. 1300SA, describes the selection, operation, and maintenance of hydraulic fluids for industrial machinery. It contains information on general qualities, lubricity, viscosity, viscosity index, oxidation resistance, neutralization number, rust and corrosion, demulsibility, foam, cavitation, additives and fire-resistant fluid selection.

262 RADIAL ENGINES

Nordberg Mfg. Co.—A 16-page bulletin describes radial engines, two-cycle diesel, spark-ignition gas, and duafuel. The bulletin, No. 200A, describes recent engineering and design features which include supercharging of the spark ignition radial engines for an increase in rating of approximately 50 per cent over normally scavenged engines.

263 CLAD STEEL EQUIPMENT

L. O. Koven & Bro., Inc.—A booklet gives data on the development of properties, types, testing, design considerations, fabrication, and applications of clad steels. Another booklet covers cleaning, maintenance of clad steel equipment.

264 STORAGE TANKS

Hammond Iron Wks.—A 36-page catalog describes storage systems, including patented floating tanks of Tubeseal or Springtite construction. Vapor-lift systems, Diaflote tanks, Dialift systems, underground storage tanks, water storage tanks and treatment vessels, and the recently introduced Hammondflote cover for small vertical tanks.

265 FLOW TUBE

B-I-F Industries, Inc., Builders-Providence Div.—Corrosion resistant, plastic insert dall flow tube is described and advantages pointed out in Bulletin 115.20-1. High metering accuracy of acids, alkalies, slurries, and gases is claimed to be obtainable with lowest head loss of any known differential producer.

266 TECHNICAL BOOKS

Ronald Press—Brochures contain detailed descriptions of current technical books on mechanics, hydraulics, electronics, aerodynamics, plasticity, air conditioning, electrical engineering, etc. Basic studies and pioneering works on late engineering developments are included.

267 VIBRATION TEST MACHINES

All American Tool & Mfg. Co.—Catalog F describes five new models of vibration fatigue testing machines equipped with electronically controlled drive motors and automatic range selector for variable acceleration control. Units are said to provide infinite frequency control within the range of 5 to 100 cps, recorded on an electric tachometer.

268 CENTRIFUGAL PUMPS

Nagle Pumps, Inc.—A four page folder, Selector, gives briefing on the company's line of pumps for abusive applications. Horizontal shaft and vertical shaft pumps are shown, the latter designed to reduce stuffing box and bearing troubles.

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KEELER dk package steam generators

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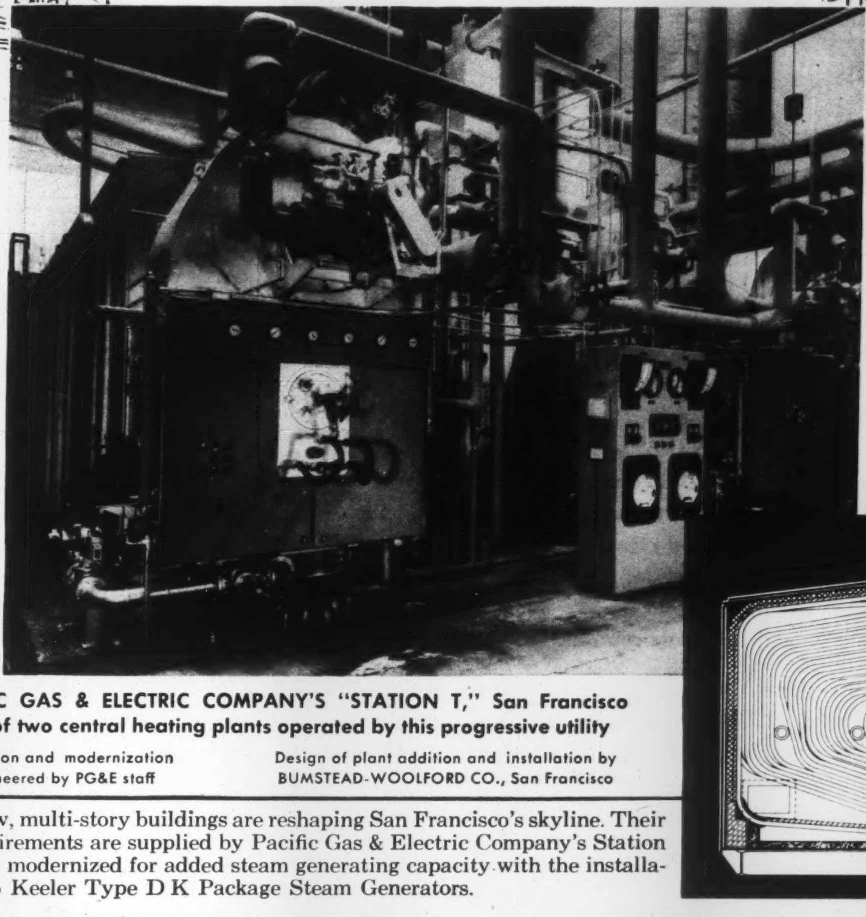

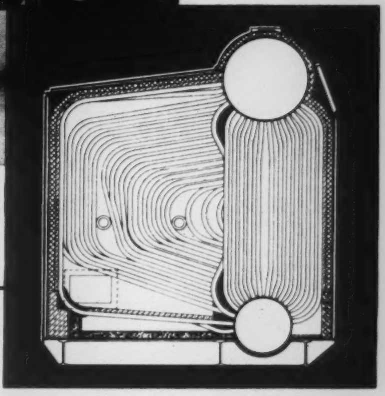

PACIFIC GAS & ELECTRIC COMPANY'S "STATION T," San Francisco
one of two central heating plants operated by this progressive utility

Expansion and modernization engineered by PG&E staff

Design of plant addition and installation by BUMSTEAD-WOOLFORD CO., San Francisco

Several new, multi-story buildings are reshaping San Francisco's skyline. Their steam requirements are supplied by Pacific Gas & Electric Company's Station T, recently modernized for added steam generating capacity with the installation of two Keeler Type D K Package Steam Generators.

PG&E is aptly described as a true partner in California's growth—in fact, by most standards, it is the largest utility of its kind in the nation! In expanding its central steam plant operations, Keeler D K's were selected to enable the firm to keep pace with the increasing demands of its clients in the "new downtown area" served by Station T.

Each of the new D K's is a 55,000-lb. stm/hr capacity unit designed for 200 psi safe working pressure and combination oil-gas firing. They are providing PG&E with a nearly doubled gross steam output in essentially the same floor space as the old boilers which they replaced.

Flexibility, however, is the big advantage—a natural for a central steam plant with unpredictable and varying loads. The Keeler D K's are efficiently handling large load swings—quickly and with a stable water level.

Multi-purpose Keeler D K's are made in 24 sizes for gas, oil or combination firing in capacities up to 80,000 lb/hr. Write for full data . . . see for yourself why this popular D-type steam generator has earned a nation-wide reputation!

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KEELER WATER TUBE *Boilers*

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- **No. F-14: Type CP Boilers**
- **No. M-2A: Type CPM Package Boilers**
- **No. MK-1: Type MK Boilers**

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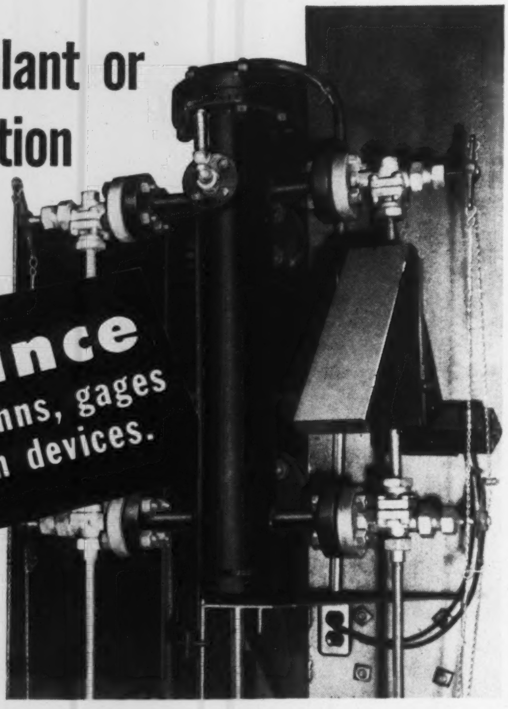

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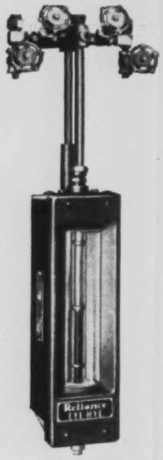

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control

Plan wisely for completely safe water level supervision on all boilers, and all water-containing vessels, with rugged, efficient Reliance equipment. This specialized line includes water columns for any type of boiler — any pressure — and complete trim, including various types of gage valves and inserts, direct-to-drum assemblies and illumination; remote reading gages, auxiliary alarms and automatic controls.

Two most valuable *additions* to your present equipment are the EYE-HYE — safe, sure *manometric* remote reading gage — and the several LEVALARMS which provide instant control of alarms, fuel cut-out and pump operation. If not acquainted with them, write for literature.

Known the world over for accuracy, sturdiness and dependability, Reliance equipment brings you the advantages of trouble-free low-maintenance service. For keeping your plant in the best of trim now, or for planning new or revised power facilities, keep posted on the latest in Reliance Boiler Safety Devices.

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269 PISTON, SEALING RINGS

Koppers Co., Metal Products Div.—A 24-page brochure illustrates and describes American Hammered piston and sealing rings for various types of industrial applications. Also available are four-page folders on conformable oil ring, marine piston rings, chrome-plated piston rings, piston rings for air and steam forging hammers, Teflon rings, railroad piston rings, and an eight-page brochure on metallic sealing rings.

270 HOT PROCESS SOFTENERS

Cochrane Corp.—Bulletin 4800 illustrates and describes hot process softeners for boiler plant water conditioning. Data is given on water treatment and the principles of operation of the firm's equipment are diagrammed.

271 INDUSTRIAL EQUIPMENT

Allis-Chalmers Mfg. Co.—Booklet 25B6057A makes reference from A to Z to literature available on the wide variety of products produced by the company. Capital goods equipment for almost every industry, in addition to construction and agricultural equipment, is covered, ranging from absorption machinery to zeolite softeners.

272 STREAMLINED BAFFLES

Engineer Co.—Bulletin BW-54 shows the design and describes the construction of streamlined baffles for many types of water tube boilers for various furnace designs and methods of firing.

273 WELL SCREEN

Layne & Bowler, Inc.—Bulletin 900 covers improved Model 134 shutter screen for gravel wall wells. Specifications are included.

274 CENTRALIZED LUBRICATION

Farval Corp.—An illustrated brochure, No. 26-T, offers 20 pages of material relating to centralized systems of lubrication. The booklet discusses principles of operation, product advantages and system components.

275 BALL BEARING SWIVEL JOINTS

Chiksan Co.—A revised 32-page catalog, G-4R covers the company's line of ball-bearing swivel joints, loading racks, manifolding lines, all-metal marine and barge hose, and flexible aircraft assemblies. Typical industrial applications are illustrated and dimensional and operating data is provided.

276 TEMPERATURE CONTROLS

Fenwal Inc.—Detailed folders describe devices for temperature detection, indication and control. Included are Thermoswitch and snap action local controls, remote bulb and capillary units, Detect-a-Fire and electronic thermistor controllers.

277 PROCESSING EQUIPMENT

Patterson-Kelley Co.—Bulletin 16 contains product description and specifications on the firm's line of blenders, vacuum tumble dryers, packaged resin-distillation pilot plants, and process heat exchangers. The bulletin also describes the organization and operation of the company's Pre-Test laboratory which, in testing customer formulations, helps determine proper blending equipment and correct blending procedures.

278 STEEL DECK GRANDSTANDS

Pittsburgh-Des Moines Steel Co.—Basic design of steel deck grandstands, their expansibility, proper seat spacing, and aisle widths are discussed in a four-page bulletin.

279 PURIFIERS, MIST EXTRACTORS

V. D. Anderson Co.—Bulletin 803 itemizes principal applications of purifiers which remove liquid, solid and dust entrainment from gases and vapors. Information on internal, receiver and line type separators, mist extractors and scrubbers is included. Exhaust heads and high pressure purifiers designed to withstand pressures to 15,000 psig are also covered.

280 PILLOW BLOCKS

New Departure Div., General Motors Corp.—Ten-page bulletin illustrates and describes ball bearing pillow blocks. Construction features, load ratings, dimensions, interchange data, and engineering data is included.

YOUR *New Catalogs* GUIDE

281 COMPRESSOR VALVES

J. H. H. Voss Co.—Bulletin 53-G covers valves for air, gas or ammonia compressors. The valves are machined from solid stock; plates are machined and ground; valves and plates are of heat treated alloy or stainless steel, for custom designed individual characteristics of compressor.

282 THERMOCOUPLE REFERENCE JUNCTION

Pace Engineering Co.—Data sheets describe a precision and a utility series of Thermocouple Reference Junctions of multi-channel temperature measurement systems. Included list of special circuit features, thermocouple combinations, specification on temperature stability.

283 COPPER CHARACTERISTICS

American Brass Co.—Publication B32 provides tables listing some of the properties of standard Anaconda copper and copper alloys. Included are compositions, forms available, certain physical properties, fatigue strength; creep strength, welding rods.

284 HIGH TEMPERATURE WATER PUMPS

Dean Brothers Pumps Inc.—Circular 214 describes the firm's line of standard centrifugal pumps for high temperature water systems used for large volume space heating and for industrial process heating. Pumps for boiler and system circulating and for boiler water make-up are illustrated. Pump data and stuffing box sealing information are also included.

285 ULTRASONIC MACHINING

Sheffield Corp.—How to use ultrasonic energy to cut, drill, emboss, engrave, slice, and dice hard and brittle metals and nonmetals is shown in Publication No. CAV 7–56. The 16-page illustrated booklet describes the ultrasonic machining process, shows examples of designs and forms machined in carbide, glass, germanium, ferrite and ceramic, and also includes specifications and machining capacities of ultrasonic machine tools.

286 WELDING FITTINGS, FLANGES

Babcock & Wilcox Co. Tubular Products Div.—Bulletin FB 78 is a guide to the selection of carbon steel, alloy, and stainless steel welding fittings for pressure uses. It covers material selection, specifications and analyses, effects of alloying elements, mechanical properties, arc welding procedures, general catalog information.

287 ROTARY SLITTING LINES

Yoder Co.—A 75-page handbook provides information on slitters and allied equipment. Basic data on design, selection and operation of slitting lines, and specifications of slitters, uncoilers, recoilers, coil cars, and scrap choppers are included.

288 RECORDING SYSTEMS

Consolidated Electrodynamics Corp.—Technical bulletins covering DataTape magnetic-tape recording and playback systems furnish descriptions and specifications for airborne and ground-based components and accessories. Ground system is described in Bulletin Nos. 1576, 1608, 1613, and 1615. Airborne components are covered in Bulletin Nos. 1592-5, 1578, and 1607.

289 EXPANSION COMPENSATORS

Flexonics Corp.—Bulletin 205 describes new high-pressure expansion compensators in stainless steel and bronze. Units have been especially designed to replace the previous methods of expansion compensation, such as slip joints, swing joints, pipe loops, or bends; units are available in pressures to 175 psig, temperatures from −60 to 250 F, with 1 3/4 in. compression and 1/4 in. extension.

290 OIL, GREASE SEALS

Federal-Mogul-Bower Bearings Inc.—Catalog 58 gives engineering, selection, and application data on oil and grease seals. The 93-page booklet illustrates the firm's National Seal Division manufacturing facilities and gives information on the various materials used in the seals.

291 WATER SOFTENERS

Permutit Co. Div., Pfaudler Permutit Inc.—Bulletin 2386-B describes trouble caused by using hard water. Equipment specifications, operating characteristics, data on ion exchange resins and typical installation photographs are included.

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292 ALUMINUM HANDBOOK

Aluminum Co. of America—A hard cover book contains data on aluminum alloys and mill products in tabular form. Information is given as reference for those responsible for planning, designing, testing, purchasing, and fabricating aluminum successfully. Form 10051.

293 COMBUSTION ANALYZER

Bailey Meter Co.—Instantaneous analysis of exit gases from all types of boiler and industrial furnaces is said to be accomplished by portable Heat Prover combustion analyzer described in Product Specification E65-5. Illustrated in catalytic combustion principle by which per cent by volume of oxygen and combustibles present in a gas sample measured and indicated.

294 MAINTENANCE IDEAS

Kano Laboratories—An alphabetical list of ideas gathered from the correspondence of industrial customers deals with problems in lubrication, stuck together metal parts, difficult metal cleaning, and lubrication of air driven tools.

295 EXPANSION JOINT DESIGN GUIDE

Flexonics Corp.—A 28-page expansion joint design guide, Catalog 182, covers engineering application and selection data. A discussion of the various types of expansion joints on the market, types of pipeline motion solved by expansion joints, expansion joint design considerations, installation instructions, and selection data is included.

296 STRUCTURAL PANEL

Philip Carey Mfg. Co.—A folder, Form No. 6293 describes a 2-in-1 insulated structural panel for interior use in duct construction, industrial ovens, coil housings, plenum chambers. It is formed of laminated plies of corrugated and flat asbestos paper sheets, bonded with a fire-resistant adhesive suitable for continuous temperature up to 1000 F.

297 DIAZO PROCESS

Charles Bruning Co.—A 12-page booklet, explains the basic principles, features, and applications of the Copyflex diazo reproduction process. Described and illustrated are the types of material available ways in which the process can be used to cut drafting time and expense, and some of the machines available.

298 VERTICAL FOUR-SLIDE MACHINE

Torrington Mfg. Co.—Bulletins V-81, V-82, and V-83 detail operating features, specifications for new Verti-Slide all-purpose vertical four-slide machine. Design details and component functions are given for feed mechanism, cam and cam shafts, drive system, and presses. Photos illustrate operation of slides, slide bases, center former, lubrication system, and clutch.

299 ALLOY STEELS

Bethlehem Steel Co.—Booklet 415-C, includes such subjects as "What is an Alloy Steel?" "Effects of Elements," "Grain Size," "Heat-Treatment," "Determining Depth Hardness." It contains nine tables of AISI and SAE specifications for open-hearth and electric furnace alloy steels-bars, billets, blooms, and slabs.

300 SPREADER STOKERS

Hoffman Combustion Engineering Co.—Catalog No. 55-CAD describes and illustrates features of moving-grate spreader stokers. Catalog 55-PDG describes, illustrates, and supplies additional information on spreader stokers with dumping grates. Capacities from 20,000 to 500,000 lb of steam per hour.

301 SOLENOID VALVES

Ruggles-Klingemann Mfg. Co—Revised Catalog E on electrically operated valves includes standard solenoid valves with improved features. Solenoid trip valves are not available with explosion proof solenoid enclosures. New additions are free handle solenoid trip valves, motor operated valve and epichron control switches.

302 MULTI-STAGE COMPRESSORS

Norwalk Co.—Catalog 44 describes features of tandem, multi-stage compressors for air and commercial gases. Pressures up to 25,000 psig.

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LATEST
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LITERATURE

303 GLASS INSULATION

Pittsburgh Corning Corp.—Six specifications cover application of the firm's Foamglas insulation for industrial equipment and piping. Each booklet contains tables of suggested thicknesses of insulation to be applied, detail drawings of installation procedure, insulation supports.

304 DIRECT CONNECTED FANS

Robbins & Myers Inc.—A 12-page pamphlet summarizing the design features and component parts of the Propellair fan. Included also are pictorial descriptions of some typical installations. In addition performance data for Propellair axial flow fans is charted. Also described is the Sky-Blast power roof ventilator.

305 PRECISION MEASUREMENT

Sheffield Corp.—A 22-page brochure describes the precision measurement and inspection services of the firm's Eli Whitney metrology laboratory. Services include calibration and certification of gage blocks, roundness determination, hardness testing, surface finish analysis, thread and plug gage calibration.

306 HYDRAULIC PULSATION DAMPENER

Westinghouse Air Brake Co., Industrial Products Div.—A four-page catalog illustrates and describes a device that suppresses the pulsations and pressure surges which reciprocating pumps, centrifugal pumps and quick closing valves introduce into hydraulic systems.

307 BEARING CUPS, CONES

Timken Roller Bearing Co.—An illustrated brochure tells how the company's continuous high-speed production methods at its Bucyrus, Ohio plant is holding down bearing costs and explains how manufacturers can benefit from these economies. Includes price index history demonstrating what these economies mean to the automotive industry. Back cover chart shows the 30 bearing cups and cones in the Green Light series which covers bore sizes from .7500 to 2.625 in.

308 VALVE OPERATORS

Ledeen Mfg. Co.—Bulletins illustrate and describe company's line of pneumatically or hydraulically operated valve operators for direct or remote control of gate, diaphragm and plug valves. Selection information, torque ratings, dimensions, and weights are given.

309 ALL-METAL FLEXIBLE HOSE

Universal Metal Hose Co.—Catalog ID-100B, describes all-metal flexible hose and tubing products. The material is edited for the selection of the proper all-metal flexible hose product for a specific application.

310 NEW METHOD OF LUBRICATION

Stewart-Warner Corp., Alemite Div.—Catalog describes new method of lubricating industrial machinery with "Oil-Mist." Bulk of publication taken up with engineering data, covering applications, operation, bearing application, bearing speeds of this method. Also for plain bearings selection of condensing fittings, intermixing of condensers, bearing grooving and many other engineering data appropriate to the subject.

311 FLIGHT CONVEYOR

Link-Belt Co.—Folder 2813 is a four-page publication on Flite-Flo, a new fully enclosed, self-cleaning flight conveyor. It gives dimensions, capacities, and other specifications on the units which can handle free flowing, granular nonabrasive bulk materials in horizontal or limited inclined paths.

312 AVIATION PRODUCTS

Aluminum Co. of America—A 16-page report covers recent accomplishments in research and development of improved products, construction of new facilities and increased production efficiency to solve aircraft industry problems of production economy and weight control in aluminum components.

313 MANUAL CHUCKS

Cushman Chuck Co.—Catalog No. 67-1959, with companion price list, contains listings and detailed engineering data on manually operated chucks for both older and new standard spindle noses.

314 STEAM TURBINES

Terry Steam Turbine Co.—Bulletins in looseleaf form which cover a complete description of Terry solid wheel turbines with cross section drawings of typical units for both moderate and high steam pressure conditions: a description of the Terry axial flow impulse, both single state and multistage; Terry gears which are used for speed increasing and speed reducing.

315 PROCESSING EQUIPMENT

Permutit Co. Div., Pfaudler Permutit Inc.—A bulletin gives data on aerators, degasifiers, deaerators, chemical feeders, precipitation equipment, filters, ion exchange equipment, gas analysis and control systems, valves, meters, flow controllers. Application photos show the equipment in various industries.

316 POLY-V DRIVE

Raybestos-Manhattan, Inc., Manhattan Rubber Div.—Bulletin M141 illustrates and describes the firm's Poly-V drive, a power transmission system that uses only two cross sections instead of five standard V-belts. The unit is said to eliminate problems of matching belts because it is a single unit across the full width of sheave.

317 PIPELINE PUMPING

Dravo Corp.—Bulletin 1704 illustrates a part of the firm's record of engineering construction of pipeline pumping and compressor stations for the transmission and storage of gas and petroleum products.

318 PNEUMATIC CONVEYING SYSTEM

Spencer Turbine Co.—Bulletin No. 143-B describes stationary and portable pneumatic conveying systems. Systems cover a capacity range from 3/4 through 10 tons per hour; vacuum producers from 5 through 75 hp, and hose or pipe sizes from 2 through 7 in. Conveying under both pressure and vacuum is covered, and applications are illustrated. Specific information is provided on size of unit, rate of conveying, and type and weight of material in each case.

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319 ELECTRONIC DATA PROCESSING

ElectroData Div., Burroughs Corp.—Eight-page Brochure No. 5220, describes latest electronic computing system designed for engineering, scientific and commercial applications. Details are given on speeds, programming, expandability, and filing capacities. Magnetic tape, paper tape, and punched card facilities available with this medium-price digital system are summarized.

320 SHAFT SEALS

Syntron Co.—Two bulletins are offered on shaft seals. One gives data and specifications on mechanical shaft seals for rotating shafts on pumps, turbines, compressors, engines, and mixers. The other covers face-type marine shaft seals which feature a split, inflatable sealing ring that permits worn seal parts replacements without dry-docking large vessels.

321 STEEL VALVES

Edward Valves, Inc.—Catalog 14 describes cast and forged steel valves for power, petroleum, chemical, marine and industrial applications. Data includes ASA dimensions, ASA pressure-temperature ratings, and ASTM basic materials specifications, as well as curves and furmulas for correlating valve size and pressure drop.

322 AIRCRAFT HANGAR HEATING

L. J. Wing Mfg. Co.—Bulletin HA-100 discusses the problems and types of systems used in heating aircraft hangars and illustrates and describes its units for steam, hot water, or gas heating. Photos and data on the company's installations or leading airline companies are included.

323 BIN LEVEL CONTROLS

Bin-Dicator Co.—Catalog describes and illustrates bin level indicators including new Roto-Bin-Dicator unit. Dimensional drawings, mounting details, typical applications, wiring diagrams, and list of present users are included.

324 CYLINDERS

Ledeen Mfg. Co.—A 12-page bulletin illustrates and describes the company's line of cylinders for air, oil, water, gas or steam operation in medium, heavy and super-duty construction. Selection information, ratings and limitations, and rod and head attachments are included.

325 STORAGE WATER HEATERS

Patterson-Kelley Co.—Catalog 19 gives capacities and weights, dimensions, conversion tables, fixture capacities, material thicknesses, heating elements and construction details of storage hot water heaters.

326 BRASS MILL TERMS

American Brass Co.—A 24-page illustrated lexicon called "Copper & Copper Alloy Metalexicon" untangles complex terminology applied to brass mill products.

327 AIR DIRECTIONAL VALVES

Westinghouse Air Brake Co., Industrial Products Div.—An eight-page catalog describes two-, three, and four-way spool type directional valves with solenoid, lever, push button, pilot cylinder, cam, treadle, and pedal operators. Valves have tapped exhaust or open exhaust.

328 PNEUMATIC CONVEYORS

National Conveyors Co.—Four-page Bulletin P58G describes pneumatic conveyor systems for handling bulk materials such as polyethylene and other types of plastic pellets, lime, alum, glass cullet, fine metal chips and borings, small parts.

329 PRESSURE VESSELS

Koven Fabricators, Inc., Div. of L. O. Koven & Brother, Inc.—Bulletin No. 550 illustrates and describes mixers, kettles, vacuum and pressure vessels, autoclaves, evaporators, impregnators condensers, stills, extractors, tanks, standpipes, piping, stacks.

330 STORAGE TANKS

W. E. Caldwell Co.—A revised 48-page catalog, No. 68, contains technical data, illustrations and price information covering metal and wood tanks with mechanical equipment and other accessories. Included are elevated and ground storage tanks, field-erected, shop build pressure, vented tanks.

331 COLD ROLL FORMING

Yoder Co.—An 88-page reference manual on cold roll forming covers operating speeds, tooling, personnel training and operating techniques, surface finish, uniformity, forming of pre-coated stock, selecting proper equipment.

332 AUTOMATIC MECHANICAL CLUTCHES

Mercury Clutch Div., Automatic Steel Products, Inc.—An eight-page folder gives specifications, applications and special data on the two general types of clutches for gasoline engines and electric motors. Also listed are representatives who are qualified to assist in the proper selection and application of the firm's clutches.

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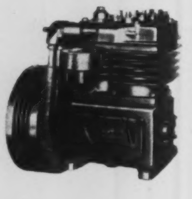

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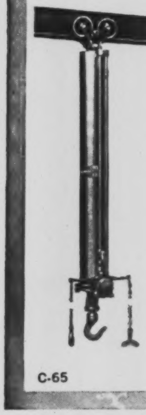

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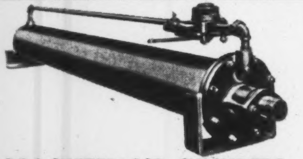

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333 DRAINLINES

Corning Glass Wks.—Eight-page, two-color bulletin on Pyrex pipe for drainlines contains case histories. Photos show installations, methods of installing, fittings available, ways to fabricate odd lengths on the job. Check list of acids to which the pipe is resistant is also included.

334 AUDITORIUM AIR CONDITIONERS

John J. Nesbitt, Inc.—Catalog 22 illustrates and describes AudiCon air conditioner, designed especially for school auditoriums and other large assembly areas where quietness is important. Unit features silencer discharge plenum, plus return air bypass control.

335 CENTRIFUGAL, TURBINE PUMPS

Aurora Pump Div., New York Air Brake Co.—Four-page catalog provides condensed specifications and description of the firm's line of centrifugal and Apco turbine type pumps. Data includes applications for the various types of pumps ranging in capacities from 1 to 9000 gpm and pressures to 400 psi.

336 AIR COMPRESSORS

Lincoln Engrg. Co.—Bulletin A-110 covers a new line of air compressors for automotive and industrial applications. More than 200 electric and gasoline driven models, ranging from 1/4 to 20 hp, are included.

337 TRI-RIB BLENDERS

Posey Iron Wks, Inc.—Bulletin No. 60 describes new Tri-Rib blenders employing the principle of counter flow for blending and mixing dry presized ingredients, or for limited applications which involve mixing dry solids and a liquid. The new Lancaster Tri-Rib blenders are particularly well adapted for mixing antibiotics, chemicals, detergents, greases, insulating materials, pharmaceuticals, resins.

338 WATER, SEWAGE EQUIPMENT

Link-Belt Co.—Book 2617, 20 pages, contains illustrations and photographs of the latest sanitary engineering equipment and also shows flow diagrams of how this equipment can be installed in typical water, sewage, and industrial waste treatment plants.

339 SCREW CONVEYOR DRIVE

Falk Corp.—Bulletin 7106 describes new drive designed especially for screw conveyors. Six unit sizes, each with four ratios, bolt to any standard trough end. Choice of seal housings are designed to assure protection between unit and any conveyed material. Optional trough end and pre-drilled motor mount are available for any size unit from 1/2 to 30 hp.

340 HIGH-STRENGTH STEELS

United States Steel Corp.—A 174-page manual discusses the essential principles of structural design and contains numerous formulas, charts and tables to assist in designing, for high-strength steels. The book covers engineering considerations and fundamental characteristics of high-strength steels, design considerations, working unit stresses, tension, compression, shear, stresses in beams, deformation and deflection.

341 AUTOMATIC LIQUID LEVEL GAGES

Liquidometer Corp.—Bulletin 463A describes 100 per cent automatic remote reading tank gages. Information on direct reading gages at tank and hydrostatic type remote reading gages.

342 BELLOWS

Flexonics Corp.—Twenty-page design guide covers application and selection of metal bellows for valve stem seals, steam traps, shaft couplings, shaft seals, and temperature or pressure sensing devices.

343 VIBRATING GRATE STOKER

American Engineering Co.–Literature describes a water cooled vibrating grate stoker in sizes from 25,000 to 150,000 lb of steam per hour. The unit does not require a dust collector and is said to burn low grade coals with efficiency or can be adapted for burning gas or oil in combination with coal or singly.

344 RING LOCKED FASTENERS

Rosan, Inc.—Literature describes studs, inserts, bolts and nuts which are locked against rotation and joint looseness resulting therefrom, by the firm's serrated locking ring. Ring locked fasteners are available for nonferrous as well as certain ferrous materials.

345 MECHANICAL VIBRATING FEEDER

Carrier Conveyor Corp.—Bulletin 591 gives details and dimensions of the new natural frequency Amplitrol feeder. The drive consists of a standard low frequency a-c motor in straignt line vibration between heavy duty pneumatic control springs. There are no moving parts to lubricate —no sheaves, gears, large bearings, variable speed drives, rectifiers, magnetic or electronic controls. Capacity is controlled by varying air pressure in the pneumatic springs.

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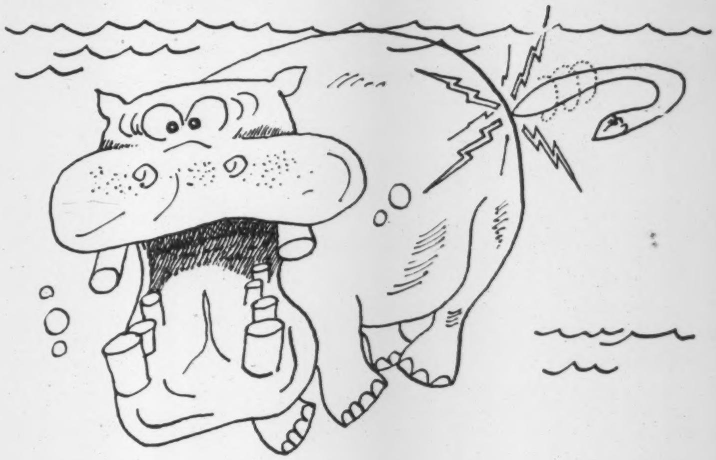
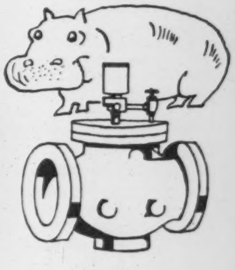


G-A *Cushioned* Solenoid Operated Valve



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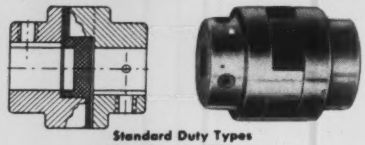

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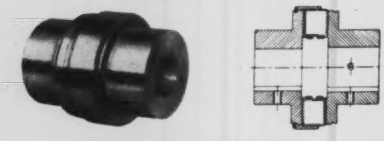

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346 WELL WATER SYSTEMS

Layne & Bowler, Inc.—Bulletin 100 contains case histories and application photos of well water systems, pumps, shutter screens, special drilling applications featuring vertical turbine pumps.

347 PROCESS INDUSTRY TUBING

Babcock & Wilcox Co., Tubular Products Div.—A 16-page bulletin, TB-417, is an illustrated booklet presenting information on the application of tubing, pipe, and welding fittings in the process industry. Selection of materials analyses, physical and mechanical properties of various tubing steels are included.

348 SPRAY SYSTEMS

Lincoln Engrg. Co.—Bulletin 404 illustrates and describes the firm's Dyna-Spray systems for paint applications. The system does not require atomizing air or material heating and is said to use only half as much material as other systems.

349 WORM GEAR DRIVES

Cleveland Worm & Gear Co.—A 16-page, illustrated brochure provides information on the firm's standard line of speed reducers, worm gear sets and special units.

350 INDUSTRIAL COOLING TOWERS

Marley Co.—Bulletin CF-59 deals with theory, design, structure and mechanical equipment of Class 600 double-flow and single-flow cooling towers. Auxiliary equipment designed to facilitate maintenance operations is described.

351 DUST FILTERS

W. W. Sly Mfg. Co.—A 36-page Bulletin 104 describes dust filters and gives engineering information on dust control systems. Operating principles of the firm's Dynaclone are described, and dust filter system specifications and hopper and support data are included.

352 FIBER GLASS INSULATION

Johns-Manville—Illustrated brochures outline advantages of both Microlite and Microtex fiber glass insulations, low-density resilient insulating materials with high thermal efficiency and sound absorption characteristics. They are described as being light in weight, resistant to heat, fire, moisture, and corrosion and the company recommends their use in applications where the greatest thermal and acoustical efficiency is desirable in the smallest space. Tables are included on thermal and acoustical performance.

353 OPTICAL PARTS

Bausch & Lomb Optical Co.—A 16-page catalog of optical parts contains information on ground glass, heat absorbing glass, retardation plates, and the firm's precision glass engraving and optical coating services. A new price list detailing up-to-date individual part prices, discount procedures is included. Catalog L-117.

354 TEMPERATURE REGULATOR

Spence Engrg. Co.—EAT series of air-controlled temperature regulators, suited for control of wide-ranging, fast-changing loads, is described. The cascade principle applied in this combination pressure and temperature control together with an exceptionally fast thermostat and modified derivative action produces superior control with only .05 to 0.1 standard cfm air consumption.

355 TECHNICAL BOOKS

Lefax Publishers—A revised catalog covers pocket size technical data books. The books cover every field of engineering, including aeronautics, air-conditioning, automotive engineering, diesel engineering, home heating, machine design, machinists' data, mechanical drawing, mechanics of materials, metals, piping data, power transmission machinery, steam engineering, thermodynamics tables and charts, general mathematics, five-place trig. and log. tables.

356 HOLLOW SHAFT REDUCERS

Winsmith, Inc.—Twelve-page illustrated catalog, covers new double reduction hollow shaft worm gear speed reducers in Series "STD" torque arm and Series "SFD" flange mounted types. They cover an output range from 0.041 to 2.552 hp, a ratio range from $66\text{-}{}^{2}/_{3}$ to 4466:1, and a maximum output torque range of 1380 to 7678 in-lb.

357 ELECTRICAL CONTROL CABINETS

Industrial Equipment Co.—Brochure shows sizes and construction of metal cabinets for electrical and hydraulic control panels. Special types shown.

358 LOCKING RING

Rosan, Inc.—Literature describes the function and application of positive lock for inserts, studs, and other threaded and nonthreaded parts in metallics and nonmetallics. Firm states design allows easy installation and replacement.

359 HOT-DIP GALVANIZING

American Hot-Dip Galvanizers Assn.—A 16-page booklet outlines rust prevention in industrial and consumer products through the use of the hot-dip galvanizing process. Included are photographs of products made by the method, and illustrations of production and quality control. Chart compares method with other types of rust prevention.

360 PUMPS AND AIR COMPRESSORS

Worthington Corp.—A 24-page brochure detailing information on Standard industrial pumps and air compressors. Also included is hydraulic data and descriptive material on Worthington steam, rotary, power, centrifugal, regenerative turbine and circulating pumps. Also compressed air data and material on Worthington air compressors.

361 EXPANSION JOINTS, PIPING DESIGN

Marquette Coppersmithing Co.—Semi-technical short report covers service history, test results, manufacturing procedures related to Omega expansion joints and their application to power and process piping systems.

362 WEDGE MANWAY ASSEMBLY

Lenape Hydraulic Pressing & Forging Co.—A unique three-piece wedge manway assembly is described in folder. This low cost manway, which employs a wedge, can be installed and opened in a fraction of the time required by conventional covers using yokes and bolts.

363 TORQUE CONVERTERS, TRANSMISSIONS

Rockwell-Standard Corp.—Bulletin SP-5803 illustrates and describes Hydra-Drive torque converters. SP-5804 covers power shift transmissions. Specifications, engineering data and selection charts are included in both bulletins.

364 METAL HOSE

Flexonics Corp.—A 36-page design catalog covers application and selection of metal hose. Various end fittings are illustrated and described.

365 RAILROAD CAR SHAKER

Webster Mfg. Inc.—Bulletin 60D illustrates and describes the car shaker, a cradle type unit weighing 3600 lb and powered by 10-hp motor. The shaker is capable of unloading coal, stone, gravel from hoppered bottom cars.

366 BELT CONVEYORS

Transall, Inc.—Four page brochure outlining the advantages of Transall prelubricated belt conveyor idlers. A check point list is included.

367 THREADED INSERTS

Rosan, Inc.—Literature describes steel insert trademarked Inserto. External thread provides anti-rotational lock. Units, designed with an internal hex, available with internal threads No. 4 through ${}^{3}/_{8}$ in. Internal thread lock optional.

368 HARD CARBIDES

Kennametal Inc.—A 44-page booklet describes basic design principles for use of hard carbides; methods of forming; methods of fastening carbides mechanically; and a general treatise of Kennametal and suggested fields of application.

YOUR *New Catalogs* GUIDE

369 WELD TUBE MILLS

Yoder Co.—A 64-page handbook describes the use of modern tube mills in the manufacture of pipe and tube. A description of the electric-weld process and photos, drawings and charts on the operation, capacities, and applications of various mills are included.

370 TORQUE CONVERTERS

National Supply Co.—Bulletin No. 496 describes single-stage torque converters for heavy industrial service, discussing background, design, types, sizes, circuits and applications. It also contains a capacity chart of the six sizes and 17 input ratings. Data sheets give application and dimension data of each of the six sizes, with performance curves, capacity chart, important features and typical torque converter arrangements.

371 TURBINE SEAL

Koppers Company, Inc., Metal Products Div.—A 4-page folder on Huhn carbon rings for steam turbine applications discusses labyrinth, carbon garter spring ring and carbon ring sealing devices.

372 DEMINERALIZING

Cochrane Corp.—A 40-page "Handbook on Demineralizing" compares various methods of water treatment, and demineralizers and evaporators. Characteristics of various types of cation and anion exchange materials are discussed and data on operating costs is included.

373 PLANT CONSTRUCTION

Nooter Corp.—Catalog No. 258 describes, by example, the firm's field construction department for fabricating and erecting processing equipment for such industries as chemical, petroleum, brewing, food, pharmaceutical, and public utilities.

374 VARIABLE SPEED DRIVES

Sterling Electric Motors, Inc.—An 8-page bulletin illustrates and describes variable speed drives for metal working, mixing, pumping, materials handling and continuous processing. Engineering, selection and operating data is included.

375 BOILERS, STOKERS

James Leffel & Co.—Descriptive and specification data on Scotch-type boilers for oil, gas, or coal firing and automatic underfeed stokers for use with Scotch-type boilers is given in illustrated 28-page Bulletin 236. Descriptive literature on outstanding installations of boilers and boiler-burner units in enclosed.

376 FLOATING PRESS NUT

Rosan, Inc.—Literature describes simple one-press operation installation in thick or thin materials. Float of .030 is provided for joint hole alignment. Available in sizes No. 4, 6, 8, 10, and 1/4 in. Internal thread lock is optional.

377 FOUR-CYCLE V-ENGINES

Nordberg Mfg. Co.—Four-cycle V-type engines are described in an 18-page Bulletin No. 262. Examples are shown of the significant advancements in diesel engine performance for V-type engines that are supercharged, supercharged and intercooled, and Supairthermal.

378 ROLLER BEARINGS

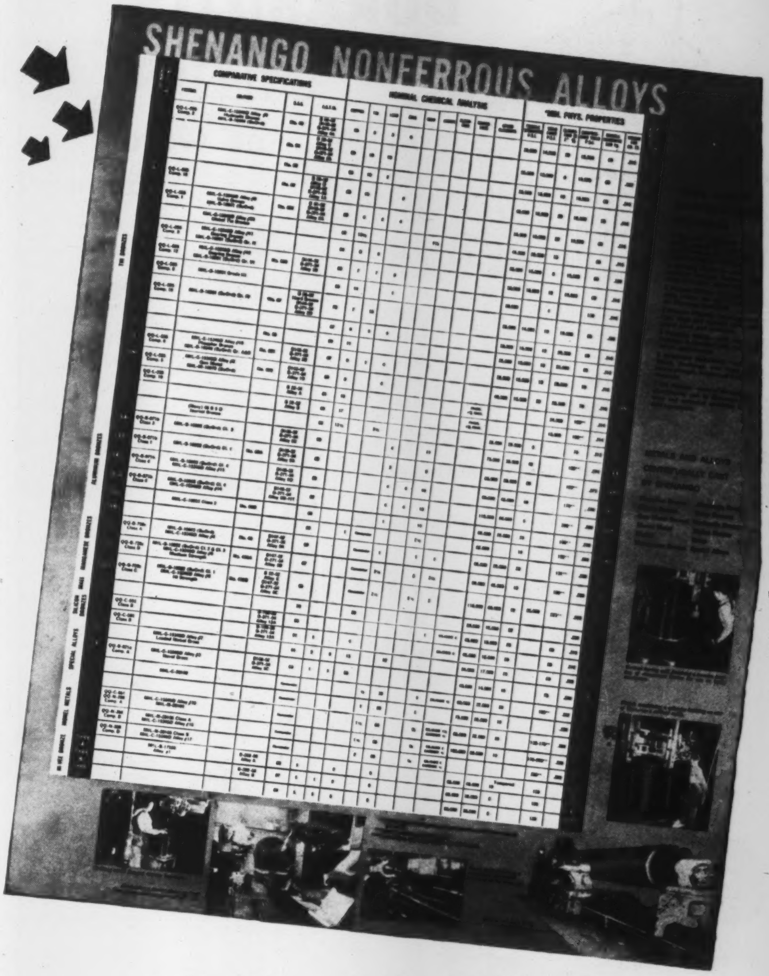
Hyatt Bearings Div., General Motors Corp.—Catalog 150 illustrates and describes solid roller bearings, wound roller solid race and split race bearings, industrial inch bearings and solid roller bearings in separable inner race, separable outer race and nonseparable types.

379 GAGE LABORATORY INSTRUMENTS

Sheffield Corp.—A 20-page booklet illustrates and describes Accutron electronic dimensional inspection instruments. Applications, specifications on electronic height gages, internal and external measuring instruments, comparators are included.

380 POLYVINYL PRODUCTS

B. F. Goodrich Chemical Co.—A booklet gives properties and illustrates applications of Geon vinyl resins for industrial and consumer uses in extrusions, film and sheeting, molded products, expanded vinyls, coatings and rigid materials.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CHICAGO SUN TIMES

DURABILITY WITH SILENCE —no water hammer!

Good news at the new Chicago Sun-Times Building! Williams-Hager *Silent* Check Valves protect the air conditioning and related piping systems. Water hammer and surge pressures are controlled by closure of valve before reversal of flow starts or when flow is zero.

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Williams-Hager *Silent* CHECK VALVES

Write for Bulletins

—No. 851 on Cause, Effect and Control of Water Hammer. No. 654 on Valves.

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YOUR *New Catalogs* GUIDE

381 ALUMINUM FABRICATION

Aluminum Co. of America—A 12-page booklet illustrates and describes the engineering, fabricating, welding, finishing, testing, and inspecting facilities at the firm's jobbing division.

382 BELT CONVEYORS

Link-Belt Co.—A 40-page handbook, Book 2779, covers the use and selection of standardized Pre-Bilt sectional belt conveyors. These are pre-engineered and shop-assembled from matched components, and are adaptable to a large proportion of belt conveyor applications and operating conditions.

383 CONTROLLED-AIR-DEVICES

Bellows Co.—Bulletins BM-25 and ML-5 illustrate and explain air motors and the choice of built-in valves and auxiliary hydraulic controls available for them. Bulletin ML-5 also describes the basic types of complete-work-units, such as power feeds, work feed tables, drilling units. Both booklets contain application photographs.

384 OIL, FLUID SEALS

National Seal Div. Federal-Mogul-Bower Bearings, Inc.—Catalog 58 covers selection, application, maintenance of 40 different types of oil and fluid seals. More than 3000 sizes are listed.

385 COMPRESSION PACKINGS

E. F. Houghton & Co.—A catalog describes a new, simplified line of rod and sheet packings. The firm manufacturers hydraulic and pneumatic packings of rubber, Teflon, and leather.

386 CUSHIONED AUTOMATIC VALVES

Golden Anderson Valve Specialty Co.—A comprehensive catalog of technical bulletins in a looseleaf ring binder covers the firm's line of special cushioned automatic valves. Included are swing check valves, surge relief valves, water reducing valves, altitude control valves, float valves, liquid strainers, solenoid operated valves, control valves, electric check valves, triple-acting nonreturn valves, engine stop valves.

387 GRAVITY FEEDER

Stock Equipment Co.—Eight-page bulletin gives details of construction and operation of gravimetric feeders designed to feed coal by weight to pulverized fuel and cyclone fired boilers. The theory of design is outlined and operating characteristics are illustrated.

388 PUMPS, SEPARATORS

Kraissl Co.—Revised Bulletin A1803 gives information on air compressors, vacuum pumps, rotary positive displacement liquid pumps, separators, strainers, filters. The firm's Class 60 series pumps, both direct and reduction drive models, are UL listed.

389 STAINLESS AND HIGH ALLOY PIPE AND TUBING

Trent Tube Co., Subsidiary of Crucible Steel Co. of America—A 48-page manual detailing the complete operation of Trent Tube, manufacturers of Contour Trent Tube, manufacturers of Contour Trentweld, stainless steel and high alloy pipe and tubing. Included is information on Tubing Classifications—plus charts and tables applying to each class. Corrosion characteristics, weights, properties of alloys and conversion tables.

390 MISSILE LAUNCHING EQUIPMENT

Loewy-Hydropress Div. Baldwin-Lima-Hamilton—Bulletin 14.004-B shows a revised and supplemented collection of the firm's activities in the field of missile ground handling and launching equipment, including the ship motion simulator for the Navy's ballistic missile program.

391 SPEED REDUCERS

Farrel-Birmingham Co.—Bulletin No. 450-A, "Farrel Speed Reducers," illustrated 52-page booklet contains full information about speed reducers. Included are horsepower rating table, specifications, dimensions, weights, and other data required for quick selection of speed reducers for various applications.

392 ELEVATED TANK

Graver Tank & Mfg. Co.—Colored folder sets forth the design features and advantages of a new form of elevated water tank called Aquatore. Tank designed as a torus tank on a flared column, provides storage for 300,000 to 3,000,000 gal.

393 ELECTROMAGNETIC CLUTCHES

I-T-E Circuit Breaker Co.—Information on its complete line of electromagnetic clutches, in six series with torque capacities from 1.8 through 13,000 lb-ft is furnished in a 20-page bulletin. Design, specification and application material, including photographs, drawings, and sketches, are included.

394 TORQUE WRENCHES

P. A. Sturtevant Co.—The second edition of a 28-page illustrated manual giving details on torque principles and various types of equipment for measuring torque is available. Included are torque specification chart, data on attachments, formulas and computations, adapters, extensions and assembly characteristics.

395 NICKEL STEEL

International Nickel Co.,—Six-page bulletin contains information on ASTM specifications, tensile, impact, and fatigue properties of 9 per cent nickel steel. Also indicates welding methods and gives data on the properties of weldments as well as the thermal conductivity, thermal expansion, magnetic properties and elevated termperature characteristics of the alloy.

396 HYDRAULIC MULTIPRESS

Denison Engrg. Div., American Brake Shoe Co.—Bulletin 324 describes the firms' new line of bench type hydraulic presses with capacities of from 1 to 12 tons. Data on special features and dimensions are given as well as available accessories and production advantages.

397 CHEMICAL PROCESS PUMPS

Dean Brothers Pumps, Inc.—Circular 217 illustrates, describes, and gives capacities and specifications of a new line of chemical process pumps, Type "pH". Fourteen sizes in both horizontal and vertical are furnished in 14 corrosion resistant alloys.

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New Catalogs

GUIDE

398 GATE VALVES

W-K-M Div., ACF Industries, Inc.—Catalog 1200 describes new pressure sealing gate valves with double-action floating seats for positive seals both up and downstream. Through-conduit, stainless stem, slab-type gate, anti-friction bearings, and other features are described. Sizes are 2 to 12 in., ASA 150 lb and 300 lb.

399 VINYL PIPE

A. M. Byers Co.—PVC pipe catalog, second edition, contains new corrosion resistance ratings, expanded information on abrasion resistance, thermal compensation, vacuum service. It includes dimensional and temperature vs. pressure data for Schedule A tubing. Sections describing installation procedures and applications have been enlarged. Diagrams illustrate methods of joining PVC pipe to other materials.

400 HEAVY-DUTY BEARINGS

Torrington Co.—Catalog 359 gives data on design, load capacity, installation, lubrication, dimensions of heavy-duty roller bearings.

401 VIBRATING FEEDERS

Syntron Co.—A 32-page catalog covers standard and special model electromagnetic vibrating feeders for hard-to-handle bulk materials. Descriptions, data, and specifications along with installation photos and application diagrams.

402 REMOTE CONTROL SYSTEMS

Teleflex, Inc.—Twelve-page bulletin illustrates and describes various remote control systems for airframe applications, missile applications, jet engines. Engineering information on cable and conduit is included, along with data on component parts.

403 PACKAGE WATER TUBE BOILER

E. Keeler Co.—A 10-page catalog on water tube package boilers contains illustrations and data on a unit available in capacity range of 6000 to 60,000 lb-steam per hour.

404 AIR DIAPHRAGM CYLINDERS

Westinghouse Air Brake Co., Industrial Products Div.—A four-page catalog illustrates and describes diaphragm air cylinders and diaphragm air chambers with effective areas from 9 to 50 sq in. and strokes from $1^3/_4$ to 4 in.

405 PRESS NUT

Rosan, Inc.—Literature describes simple one-press operation installation in thick or thin materials. Firm states maximum push out and torque out are effected by exclusive locking system. Internal locking thread is optional. Units are available in sizes No. 2 through $^3/_8$ in.

406 HEATERS, HEAT EXCHANGERS

Patterson-Kelley Co.—Catalog No. 202 contains 36 pages of product data and application tables for instantaneous hot water heaters and heat exchangers. Data includes dimensions, standard connections, piping arrangements, and diagrammed line drawings of two-, four-, and six-pass instantaneous heaters, plus condensate coolers (or preheaters) and booster heaters constructed in accordance with ASME code requirements.

407 ASBESTOS-CEMENT BOARD

Phillip Carey Mfg. Co.—Form 6285 describes asbestos-cement board for exterior walls, partitions, linings, utility structures. The material is not affected by most acids, alkalis, fumes, heat, cold, weather, salt air. It is vermin and rodent proof, will not rot, rust or corrode, and needs no paint or protective coating. It can be painted for decorative purposes. Suitable for continuous temperatures up to 600 F.

408 PNEUMATIC CONVEYING SYSTEM

Spencer Turbine Co.—Bulletin No. 143-B describes stationary and portable pneumatic conveying systems. Systems cover a capacity range from $^3/_4$ through 10 tons per hour; vacuum producers from 5 through 75 hp, and hose or pipe sizes from 2 through 7 in. Conveying under both pressure and vacuum is covered, and applications are illustrated.

409 HIGH-STRENGTH STEEL

United States Steel Corp.—Form ADUCO-02741, 24 pages, describes properties and characteristics of low-cost, low-alloy high-strength steel. Applications are illustrated.

410 PILLOW BLOCK BEARINGS

Triangle Mfg. Co.—Forty-page catalog covers applications, variations, lubrication, and installation of pillow block bearings and mountings. Included are sleeve-type, self-aligning pillow blocks,single-bolt mountings, wall bearings, pedestal bearings, tri-arm bracket assemblies, plain and cushioned flange mountings.

411 DEAERATORS

Permutit Co. Div., Pfaudler Permutit Inc.—Bulletin No. 2357 describes the company's spray type deaerating heater. The principles of deaeration and the part it plays in corrosion prevention are described and illustrated. The deaerating heater is designed to protect equipment from corrosion by removing oxygen, carbon dioxide and nitrogen.

412 AUTOMATIC DATA SYSTEMS

Hagan Chemicals & Controls, Inc.—Bulletin MSP 161 describes Kybernetes automatic data processing systems. The electronic equipment logs, monitors, computes any number of input variables at 0.1 per cent overall full scale accuracy. Bulletin includes basic design parameters and technical description of various stages of the equipment.

413 QUICK HOSE-CONNECTOR

Besler Corp.—Folder gives data on a quick hose-connector for pressures to 5000 psi. The unit, used on military aircraft, is designed for high pressure gas and liquid. Data is also provided on a new tank pressurizing control valve.

A world of facts at your finger tips. Use coupon on page 140 for free catalogs you need.

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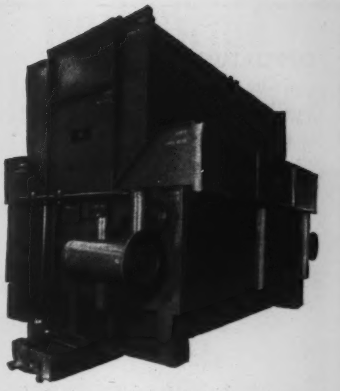

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VISCOSITY OF LUBRICANTS UNDER PRESSURE

This Report reviews twelve experimental investigations made in England, Germany, Japan, Russia, and the United States on 148 lubricants comprising 25 fatty oils, 94 petroleum oils, 17 compounded oils, and 12 other lubricants. Data collected are co-ordinated by means of sixty tables in which the results originally appearing in diversified units are compared. The methods proposed for correlating viscosity-pressure characteristics of oils with properties determined at atmospheric pressures are reviewed and illustrated. Pertinent topics such as experimental work on heavily loaded bearings, lubrication calculations, and additional techniques for viscosity are covered. Conclusions and recommendations are presented. Other sections give the required computation of temperature and pressure coefficients, a bibliography of 189 items, and symbols.

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YOUR *New Catalogs* GUIDE

LATEST INDUSTRIAL LITERATURE

414 BELT FEEDERS

Stock Equipment Co.—Eight-page bulletin illustrates and describes volumetric belt feeders, designed to assure reliable flow of coal to pulverizers and cyclone burners. The unit provides for an unrestricted 24-in. width of coal stream.

415 POWER PLANT CONTROLS

General Regulator Corp.—Electric, hydraulic, and pneumatic controls for power plants, test facilities, machine automation and industrial processes are described in consolidated catalog. Also four basic types of desuper-heaters, control dampers, and nuclear reactor actuators.

416 PLATE FABRICATION

Graver Tank & Mfg. Co.—Employes magazine summarizes this fabricator's services. Feature story describes geodesic dome built as a repair shop by Union Tank Car Co. at Baton Rouge. Other stories cover refining vessels, alloy process equipment, an industrial sprinkler tank installation and oilfield equipment.

417 LUBRICATION RECOMMENDATIONS

Shell Oil Co.—A bulletin gives detailed lubrication recommendations for contractors' equipment, including gearing, wire ropes, pneumatic tools, power steering, etc. Another bulletin illustrates and describes the company's Rotella T oil, a heavy duty motor oil for truck fleet operators.

418 GRINDING WHEELS

Norton Co.—A 30-page catalog with net price supplement covers Alundum and Crystolon grinding wheels for all types of operations. Also information and prices on abrasives for polishing and Tumblex abrasives for barrel finishing.

419 OIL AND GAS BURNERS

Engineer Co.—Bulletin G 59 illustrates different types and sizes of gas and oil burners and includes engineering data and specifications for pumping and heating sets for all types of liquid fuels.

420 HYDRAULIC BUFFERS

Houdaille Industries, Inc., Buffalo Hydraulics Div.—Brochure describes the operation and use of hydraulic buffers. Applications include emergency stops, droppable containers, missile launchers, gate damping, shock and vibration control. The unit is available in sizes varying from 100 to 200,000 lb load.

421 PRECISION COMPONENT

PIC Design Corp.—New 416-page Master Catalog lists with drawings and prices of 10,000 stock parts for breadboard, development, and production. The catalog includes gears, differentials, speed reducers, shafts, gearings, couplings, breadboard, kits, tool components.

422 HYDRAULIC VALVES

Waterman Engrg. Co.—Catalog covers pressure-compensated fixed and adjustable flow regulators, full-flow pilot-operated solenoid valves, filters, check valves, unloading valves, counterbalance valves, and other hydraulic power system components. Most components are rated at 3000 psi. Special designs are available for special purposes.

423 STORAGE TANK HEATING

Hynes Electric Heating Co.—Eight-page bulletin describes application of tubular heaters to storage tank heating of temperature sensitive materials. It contains nomographs to facilitate determination of KW requirements and other technical data.

424 TRANSDUCERS

Consolidated Electrodynamics Corp.—A 16-page folder, No. 1308, on transducers and associated equipment, illustrates and describes vibration pickups, velocity pickups, torsiographs, pressure pickups, dynamic pressure pickups, galvanometers, and telemetry equipment.

425 BOILER SAFETY DEVICES

Reliance Gauge Column Co.—Bulletin 516 is a condensed catalog of water columns, water-level gages and accessories, and liquid-level alarms. It is a key to more complete catalog sections describing this class of equipment is made by Reliance.

426 SQUIRREL CAGE MOTORS

Sterling Electric Motors, Inc.—A 64-page catalog illustrates a-c squirrel cage motors, speed reducers, and variable speed drives. Featured additions are right angle gear motors, right angle variable speed drives, and an expanded range of variable speed drives from 4660 to 1.3 rpm in variations from 2:1 and 10:1.

427 TIME ORGANIZER

Kano Laboratories—Literature describes a time organizer system in which items are listed on numbered lines and checked out as completed. The system includes a three-year calendar, annual and monthly check charts and detailed suggestions for use.

428 HEAVY DUTY V-BELT

Raybestos-Manhattan, Inc., Manhatten Rubber Div.—Bulletin M210 describes a new Condor LS V-belt made for long center, heavy duty drives. The belt features a precision proportioned construction to eliminate V-belt whip and turn-over.

429 COUNTING DEVICES

Veeder-Root, Inc.—Modern mechanical electrical, and electronic counters for all industrial and special counting requirements are briefly described in a four-page condensed general catalog. Also contains information on applications and how-to-order.

Definitions of Occupational Specialties in Engineering

This book contains comprehensive data related to all activities and specializations in engineering including specific knowledge and duties, responsibilities and related techniques necessary for successful performance in each field.

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YOUR New Catalogs GUIDE

LATEST INDUSTRIAL LITERATURE

430 HYDRAULIC MACHINERY

Loewy-Hydropress Div. Baldwin-Lima-Hamilton—Bulletin 14,002 is a comprehensive catalog on hydraulic presses for extrusion, forging, die-forging, deep-drawing, Marforming, bending, upsetting and other metal forming operations. It also describes hydraulic stretch-straightening-detwisting machines, stretch-straightening machines for plate and sheet, and pipe testing and expanding machines.

431 TOOL STEEL

Crucible Steel Co. of America—Series of five booklets contains reproduction of presentations made before the firm's tool steel clinics. Data and discussion covers virtually every phase of application, selection, manufacturing of various steels.

432 PNEUMATIC INSTRUMENTS

Republic Flow Meters Co.—Six specification folios cover null-balance-vector pneumatic instruments for utility and process control systems. Described are controller, pressure transmitter, differential pressure transmitter, temperature transmitter, and ratio relays.

433 HYDRAULIC TURBINES

James Leffel & Co.—Details on turbines which drive both power generating and pumping units at the United States Bureau of Reclamation's Chandler Power and Pumping Plant are given in 12-page Bulletin 1098-E. Descriptive literature on other recent turbine installations is enclosed.

434 DEEP DRAWN SHELLS

Pressed Steel Tank Co.—A bulletin summarizes basic applications and economies possible using seamless cupped and deep drawn ferrous and nonferrous shells. Included is information on head shapes and types of open ends available, practical diameter to length ratios, wall thicknesses.

435 FRACTIONAL HP MOTORS

Robbins & Myers, Inc.—A ten-page booklet describes its new line of Model R re-rated fractional horsepower motor available in ratings from 1/8 to 1 hp in polyphase, capacitor single phase, permanent split capacitor and (in the smaller ranges) split phase types. Totally-enclosed designs.

436 CONSTRUCTION ALLOY STEEL

United States Steel Corp.—Form ADUCO-01607, 64-pages, gives information on fabrication, engineering data, and metallurgical characteristics of T-1 constructional alloy steel. Case histories of applications are included.

437 STORAGE WATER HEATER

Patterson-Kelley Co., Inc.—Twenty-page catalog describes design, operation, construction features and installation specifications of a new completely-packaged Scalefree gas-fired storage water heater.

438 PRECISION MEASURING VALVES

Lincoln Engrg. Co.—Bulletin 682 gives data on precision measuring valve systems for dispensing predetermined, metered quantities of fluids and semi-fluid materials. Operating characteristics are covered and various stationary systems.

439 TECHNICAL BOOKS AND PAPERS

The American Society of Mechanical Engineers—A 20-page catalog describing current books, standards, codes, research reports and periodicals published by the Society and a listing of available technical papers.

440 WELDED STEEL PULLEY

Link-Belt Co.—Book 2540, 8 pages, describes a new hydro-expansion-formed belt conveyor pulley designed to increase conveyor belt life, has a 25 per cent greater strength, is concentric to within .030 in. and is free from crown welds.

441 INDUSTRIAL POWER TOOLS

Rockwell Mfg. Co., Delta Power Tool Div.—Drill presses, grinders, shapers, planers, jointers, metal and wood cutting lathes, tilting arbor saws, unisaws, band saws, and radial saws are described in an 88-page catalog. Specifications, catalog listings, and descriptions of accessories for all tools are included.

442 GAGING APPLICATIONS

Sheffield Corp.—A 12-page booklet shows how column type Precisionaire gages are used to inspect single and multiple, internal and external dimensions and other geometrical conditions and relations.

443 DOME PRESS NUT

Rosan, Inc.—Literature describes simple one-press operation installation in thick or thin materials. Firm states ideal fastener for potting. Internal thread lock is optional. The units are available in sizes No. 2 through 5/16 in.

444 MOTION PICTURE CAMERAS

Wollensak Optical Co.—A catalog explaining high-speed photography, its application and the results obtainable and a folder describing the operation and uses of the Fastax high-speed motion picture-oscillographic camera are available. These cameras, used in research, design, commercial engineering, are a continuous moving film type with rotating prism positioned between the lens and the sprocket. They are available in 8, 16 and 35 mm in both 100 and 400 ft capacity.

445 HYDRAULIC POWER

Denison Engrg. Div., American Brake Shoe Co.—Bulletin 220 describes the firm's line of hydraulic components including pumps, motors, pumping units, and controls. Operating characteristics of typical units are shown in tabular form.

446 AIR COCKS

Westinghouse Air Brake Co., Industrial Products Div.—A four-page catalog illustrates and describes plug type and diaphragm type two and three-way cut-out cocks for pneumatic systems.

447 PROCESS CONTROL

Swartwout Co.—Bulletin describes electronic control and instrumentation for processing, power generation (including atomic energy), testing, research and development. Principles of electronic transmission and control are discussed together with benefits, i.e., zero transmission lag, zero hysteresis and infinite resolution by continuous (stepless) modulation.

448 TOOL STEELS

Crucible Steel Co. of America—A six-page index to Crucible tool steels and AISI type classifications. The cross index is an aid to making an accurate identification and selection of tool steels for specific jobs.

449 BEARING, JOINT SEALANTS

American Sealants Co.—Easier tolerances and improved alignment made possible with new techniques for retaining anti-friction bearings with Loctite sealant are described in a brochure. Also included is information on how to stop breakdowns due to loose nuts and bolts by using the liquid lockwasher and how to seal joints against high fluid pressures without mixing or pot life problems.

450 STEAM TURBINE

Dean Hill Corp.—Bulletin 2001 describes a single-stage, mechanical drive turbine, centerline-mounted to minimize shaft misalignment due to thermal expansion. The unit, for requirements up to 1000 hp with inlet pressures up to 875 psig, is adaptable to natural gas expansion and to other gases such as freon.

451 STAINLESS STEEL

U. S. Pipe & Foundry Co.—Steel and Tubes Div.—Technical bulletin illustrates and describes how centrifugal castings are made, effect of coarsely columnar cast structures upon mechanical and corrosion resistant properties of austenitic stainless steels; method of preparing test specimens; test results: mechanical properties and corrosion resistant properties.

452 INDUSTRIAL DOORS

Kinnear Mfg. Co.—Bulletin No. 101, a 36-page catalog, illustrates and describes the firm's line of doors and accessories for industrial use. Specifications on types and sizes of various doors are included, along with application information.

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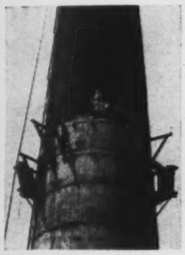

Restoration work on concrete chimney showing new material being bonded before waterproofing.

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LATEST INDUSTRIAL LITERATURE

453 ABSORPTION COLD GENERATOR

Trane Co.—Catalog covering the firm's absorption cold generator describes product features, absorption operational cycle, hermetic pump operation, purge design, and gives roughing-in dimensions and specifications.

454 FILTER UNIT

Hankison Corp.—Bulletin F-100 describes the firm's Refrigifilter, a compact new unit that contains a condenser-evaporator, filter cartridge element, heat exchanger, automatic condensate discharge trap mechanism, and a self-contained refrigerator section.

455 ALLOY STEEL PIPE

U. S. Pipe & Fdry. Co., Steel & Tubes Div.—Bulletin illustrates and describes turned and bored, metal mold, centrifugally cast alloy steel pipe. Case histories are given, along with a description of the manufacturing process.

456 GAS-EXPANDING TURBINES

Dean Hill Corp.—Bulletin 2000 describes reversible Type GET gas-expanding turbine, designed for 1 to 45 hp, with 1000 psig maximum inlet pressure. Designed for recapturing horsepower in pressure-reducing applications, the turbine is also adaptable to steam, freon, or other gases.

457 THERMOCOUPLE SYSTEM CALIBRATOR

Pace Engineering Co.—A manual gives the theory and operation of equipment for calibrating multichannel thermocouple recording systems. The calibrator is one in which the reference temperature and scale are established by injection of monitored voltages supplied by two mercury cells.

458 LEASE AUTOMATION SYSTEMS

Black, Sivalls & Bryson, Inc.—Packaged lease automation from wellhead to pipeline provided by the firm's new Phanto-Matic lease system, is described in a 20-page catalog. The system offers fully automatic wellhead shut-in control, well test control, well flow control, tank switching, custody transfer, fluid metering, and lease safety controls.

Your NEW CATALOGS GUIDE offers readers of MECHANICAL ENGINEERING an opportunity to secure advertisers' latest industrial literature available. In this issue there are 458 items to make selections from. For convenience an index may be found on pages 139-141. Select desired catalogs by number, requests limited to 25 catalogs. Fill in coupon on gage 140 and mail promptly. *(Must be mailed on or before date given on coupon.)*

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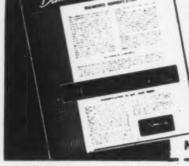

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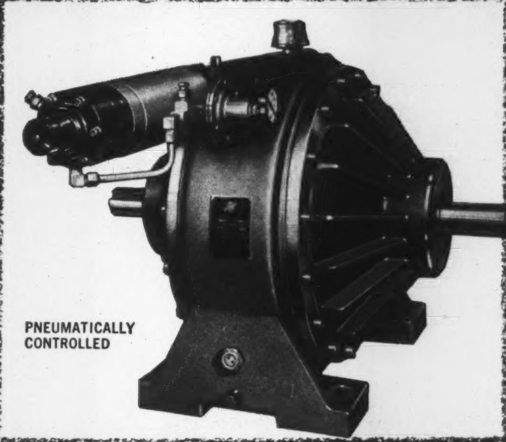
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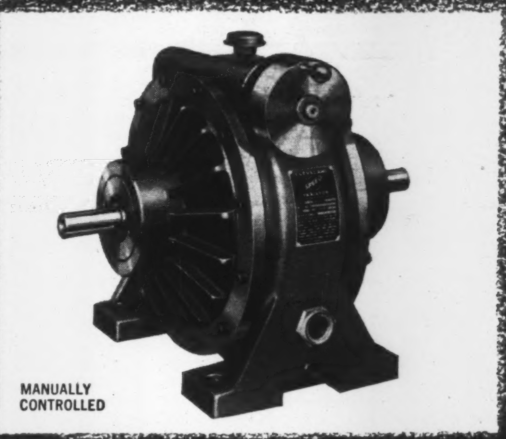
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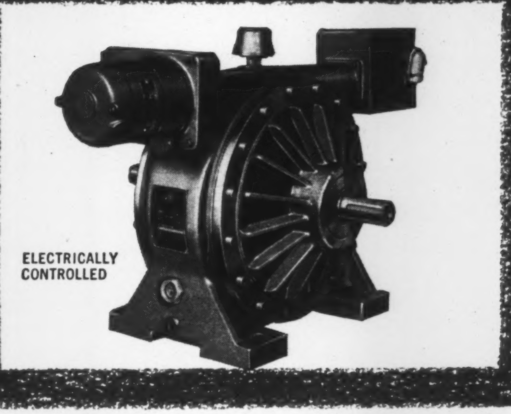
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HOW IT WORKS

Power is transmitted from input shaft to output shaft through alloy steel driving balls which are in pressure contact with discs attached to the two shafts. Relative speeds of the shafts are adjusted by changing the positioning of the axles on which the balls rotate (see cutaway view, right).

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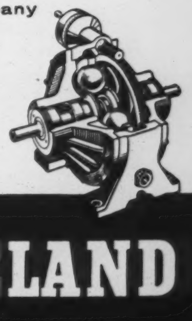

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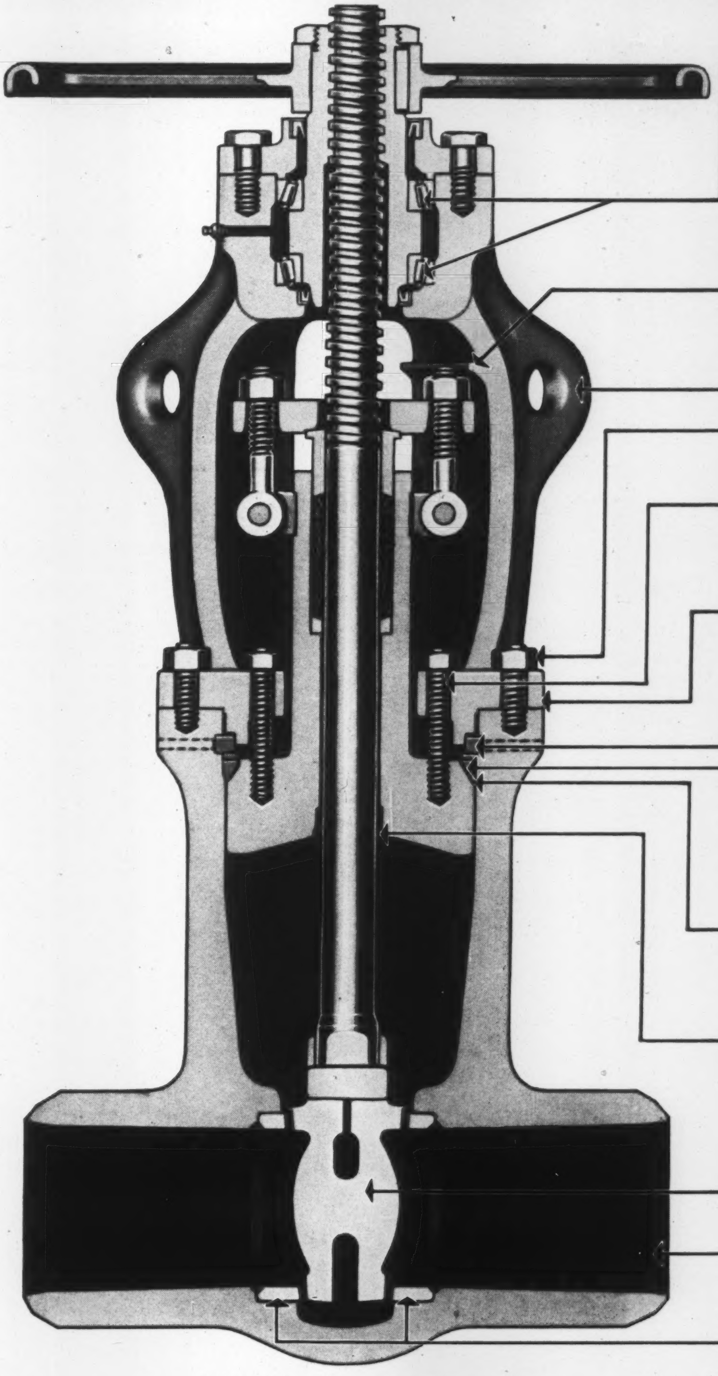

Tapered roller bearings are most satisfactory for high thrust loads.

Lugs on the inner side of yokearms provide a convenient shelf for suspending gland flange when renewing packing.

Lifting lugs facilitate handling the valve during erection and maintenance. Also provide means for supporting weight of the valve.

Body studs hold the yokearm to the body. These eliminate the need of a heavy clamp, and maintain perfect alignment and rigidity of yoke to the body.

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Streamline contour of body simplifies application and reduces cost of insulation, and effects marked savings in space and weight.

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Stellite faced back seat and stem guide insure tight sealing, accurate guiding of stem and protects packing when valve is back seated.

Flexible "H"-type wedge, which is stellited, prevents sticking because of temperature changes and pipe line stresses, thus reducing opening torque.

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Seat Rings are stellite faced, accurately machined and welded in place.

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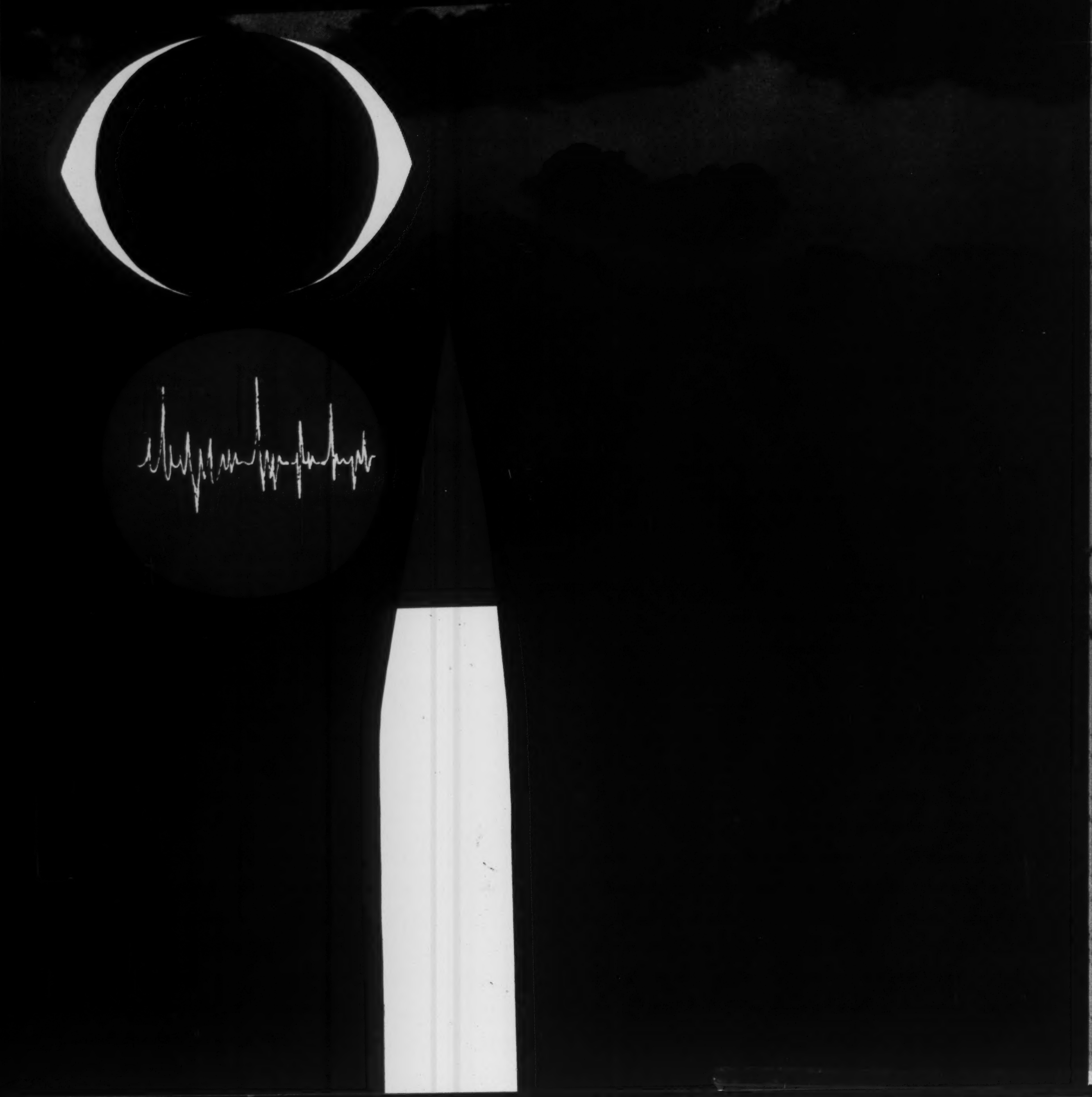

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ADSCO RAM-PAK EXPANSION JOINTS

The 5 advantages are: One-point lubrication; 2) *complete* and *uniform* lubrication of the packing assured by the lubricant dispersion ring; 3) removable packing chamber permits replacement of packing without removing expansion joints from the line; 4) rugged outward limit stop is provided by internal guide and, in addition, an outer guide is provided; 5) support base conforms in all respects to A. S. A. standards.

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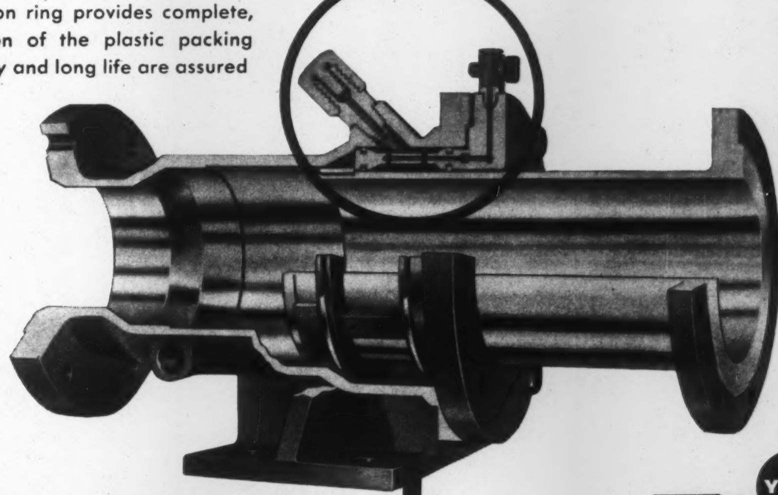
Lubricant dispersion ring provides complete, uniform lubrication of the plastic packing material. Resiliency and long life are assured



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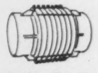

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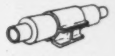
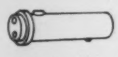


Alignment Guides



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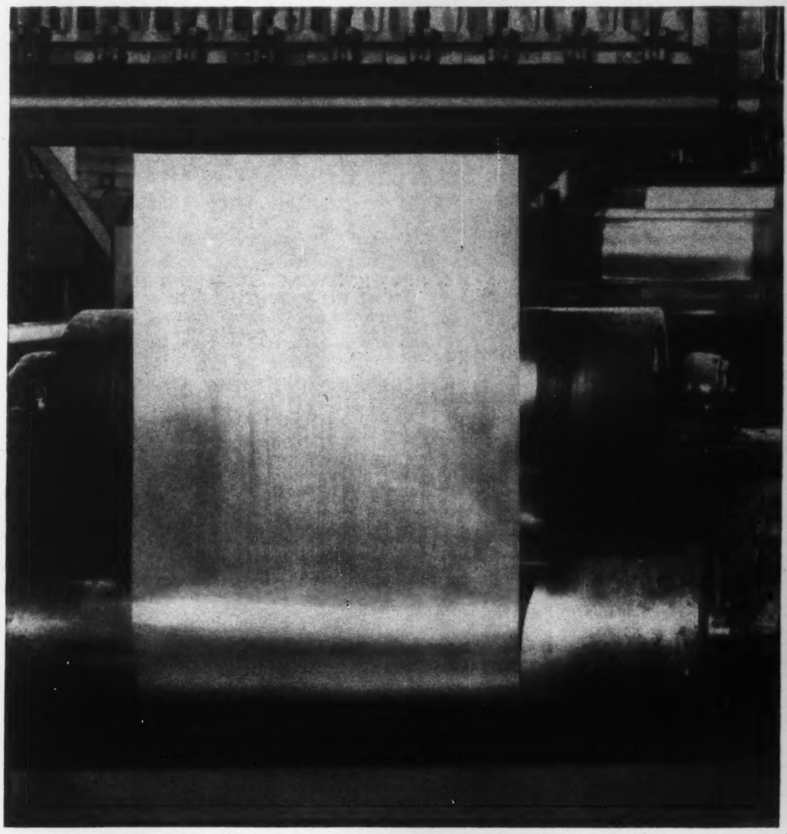

Here, the strip enters the furnace section of the line, under positive alignment and control as provided by the USS Continuous Strip Tracking System.

Continuous annealing line, Kaiser Steel Corp., Fontana, Cal.

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The System provides *constant* control of strip alignment throughout the line, without strip distortion, at speeds up to 1250 feet per minute. The specially designed roll complement, including LORIG-ALIGNER Self-Centering ROLLS, maintains strip material on the pass-line without the use of exterior controls.

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United States Steel's Strip Tracking System works equally well in either ferrous or nonferrous metal processing lines. For more information, send in the coupon.

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Test rules apply to centrifugal pumps including those of the mixed flow and axial flow types. The Code may also be used as a satisfactory guide for testing pumps handling contaminated water.

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DETERMINING DUST CONCENTRATION IN A GAS STREAM, PTC 27—1957. $2.50
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Shows how to determine those chemical and physical properties which serve as indicators of the value of liquid fuels used in equipment for the generation of heat or of power. Rules do not cover gasoline as used in spark-ignition, internal combustion engines.

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Covers testing of all types of dust separating apparatus installed for operation in conjunction with solid fuel fired furnaces.

EJECTORS AND BOOSTERS, PTC 24—1956. $2.00
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FEEDWATER HEATERS, PTC 12.1—1955. $1.50
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GASEOUS FUELS, PTC 3.3—1944. $2.00
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For conducting tests to determine the operating characteristics of producers whose gas is used for power, heating, or chemical purposes.

GAS TURBINE POWER PLANTS, PTC 22—1953. $2.00
Shows how gas turbine power plants and components should be tested.

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Includes rules for testing an individual reaction or impulse turbine unit of any type, and for index testing.

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SAFETY AND RELIEF VALVES, PTC 25—1958. $2.50
Covering valves handling steam, gases, and liquids (the physical properties of which are reliably known), this Code shows how to determine, under specified operating conditions, one or more of the following quantities or characteristics: Relieving pressure; relieving capacity at the relieving pressure; coefficient of discharge; opening, closing, seal-off, and start-to-leak pressures; blow-down; reproducibility of valve performance; and mechanical characteristics of valves as determined by seeing, feeling, or hearing.

SOLID FUELS, PTC 3.2—1954. $2.50
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"Units" to which this Code applies are combinations of apparatus for producing, furnishing and recovering heat together with apparatus for transferring to a working fluid the heat thus made available.

STEAM CONDENSING APPARATUS, PTC 12.2—1955. $2.00
These rules are for testing all apparatus whose primary function is to reduce the exhaust pressure of a prime mover to a pressure below atmosphere, and, in the case of surface condensers to condense the steam so that the condensate is available for re-use as boiler feed.

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Contains complete instructions for testing all types of modern steam turbines and for making the necessary pressure, temperature, and flow measurements.

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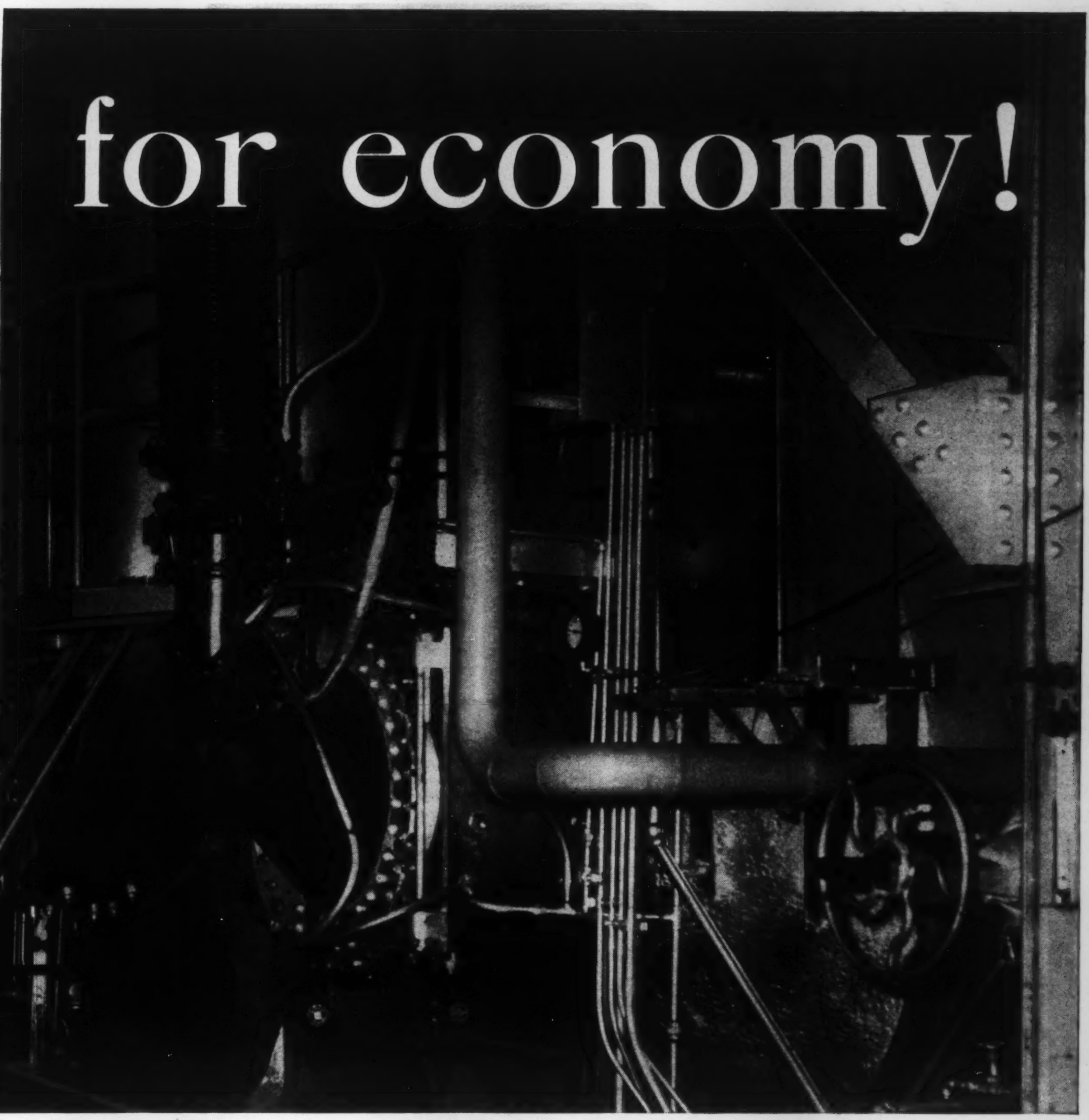

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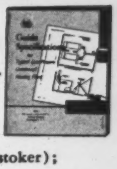

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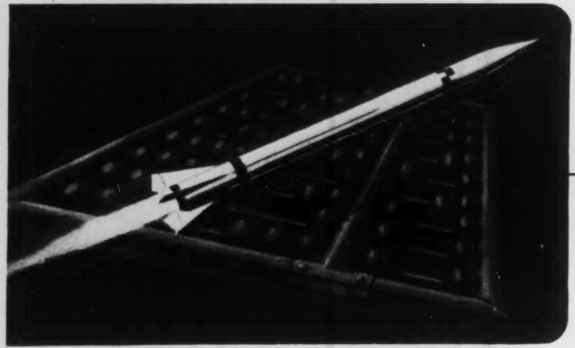

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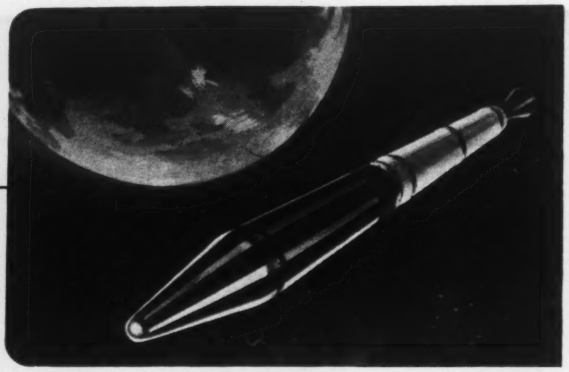

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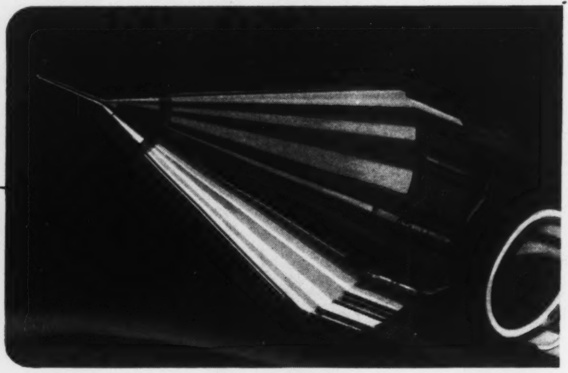

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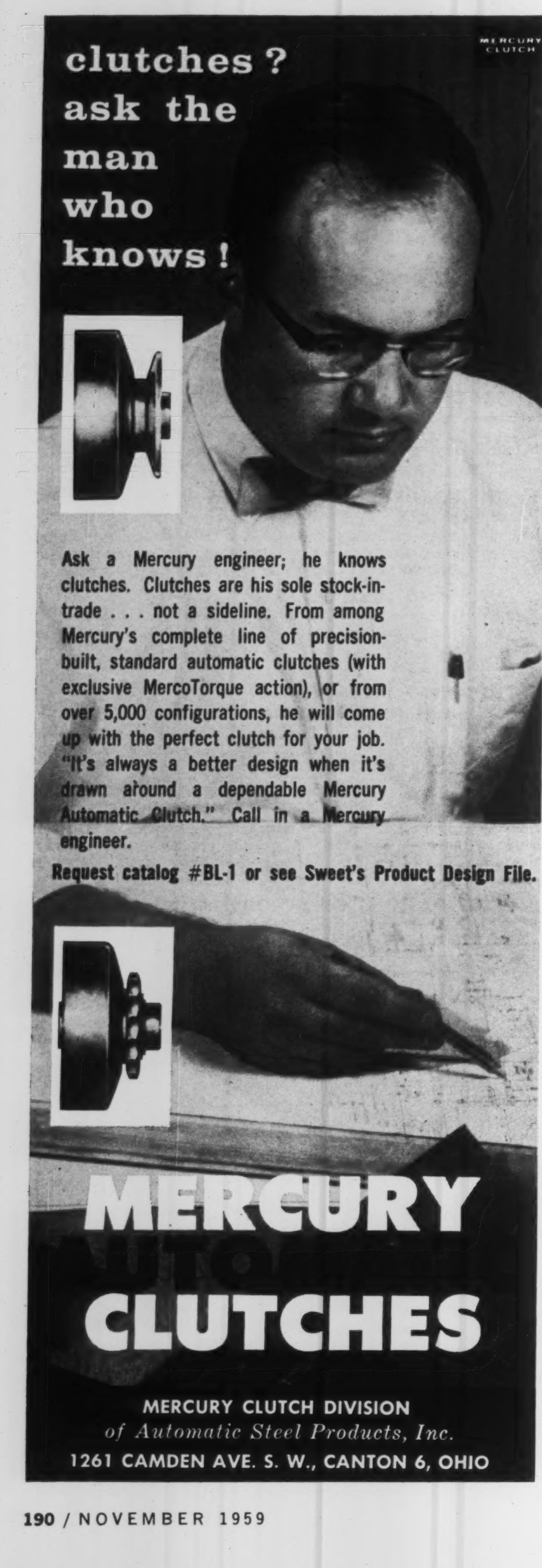

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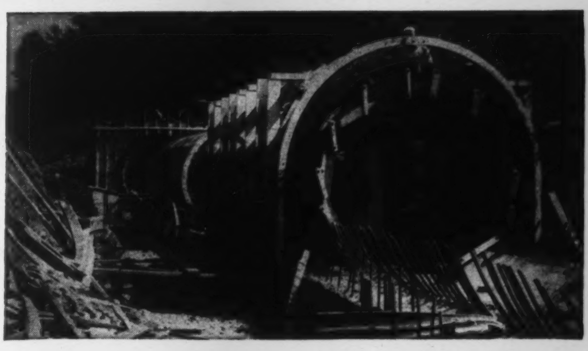

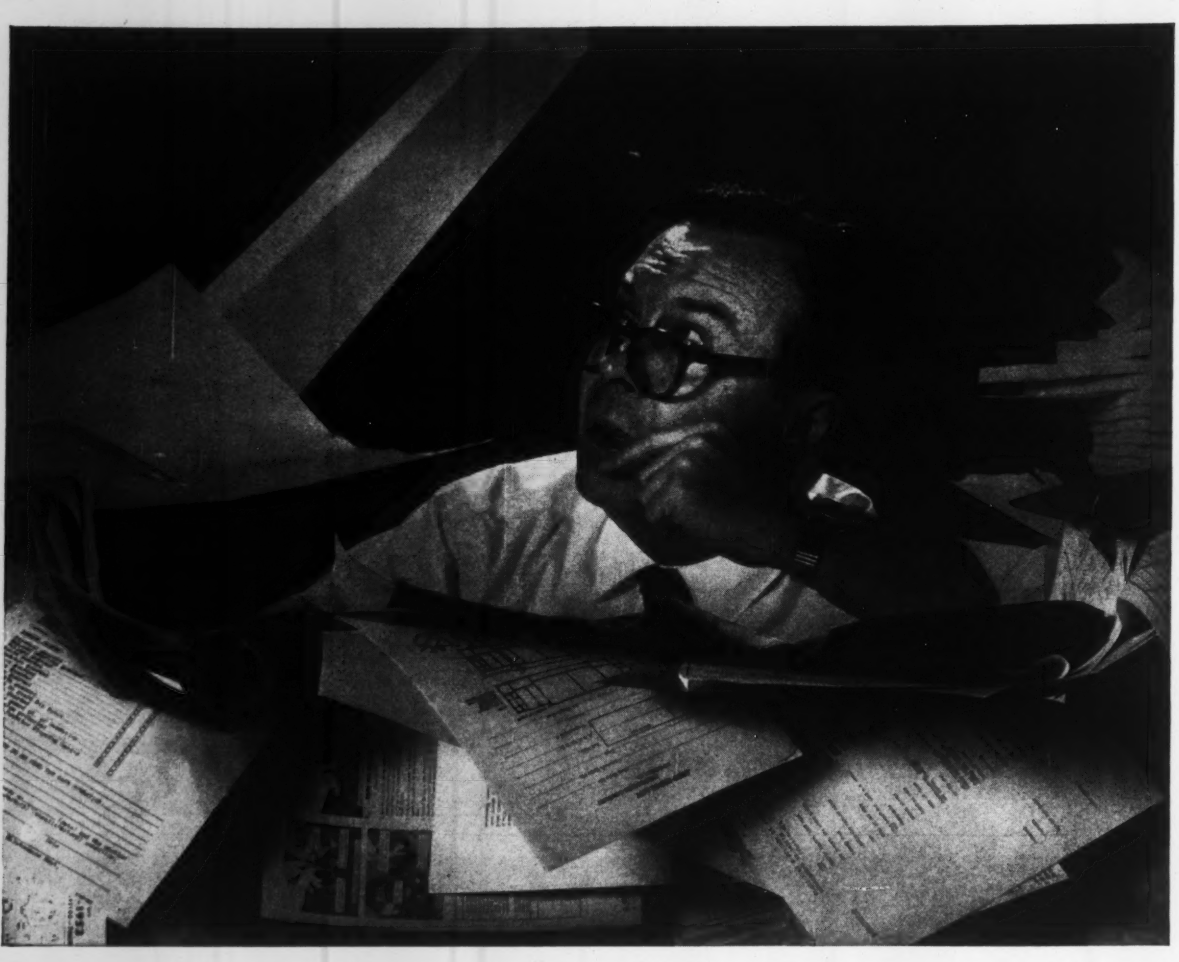

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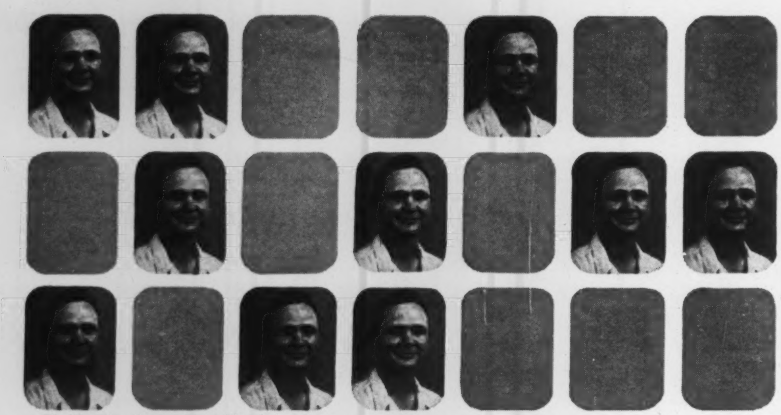

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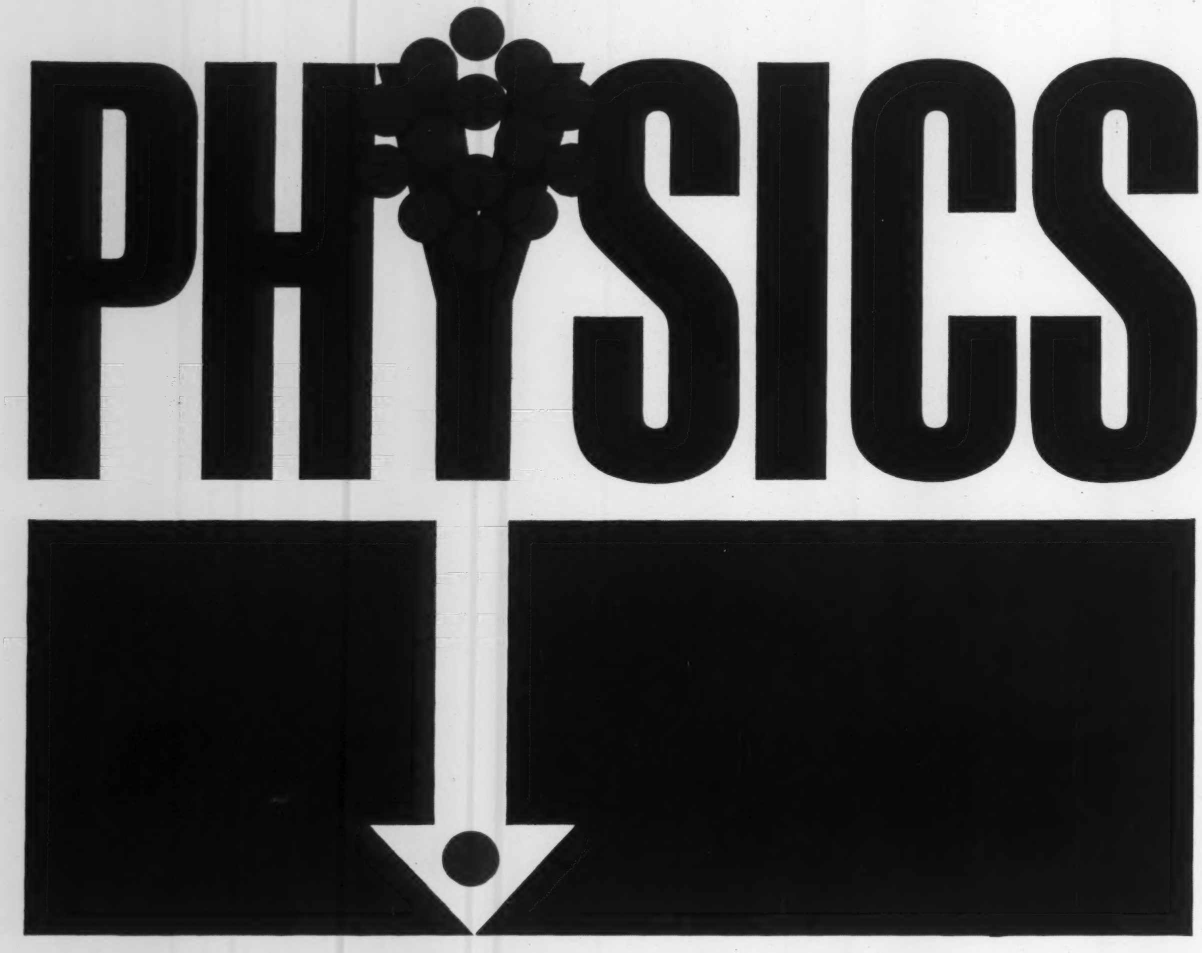

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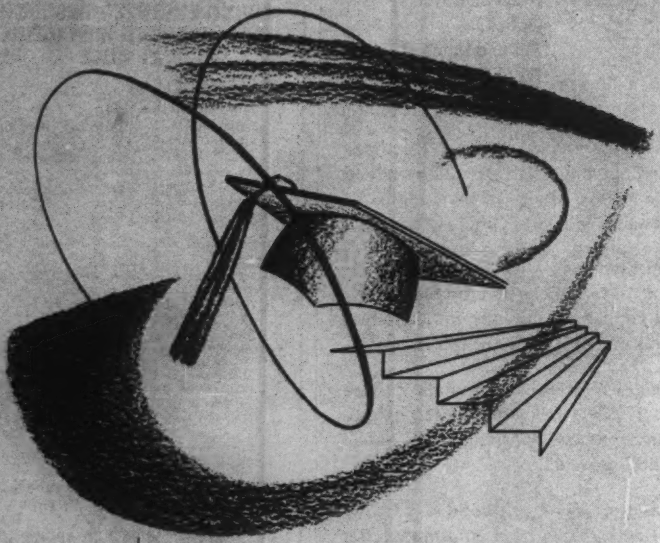

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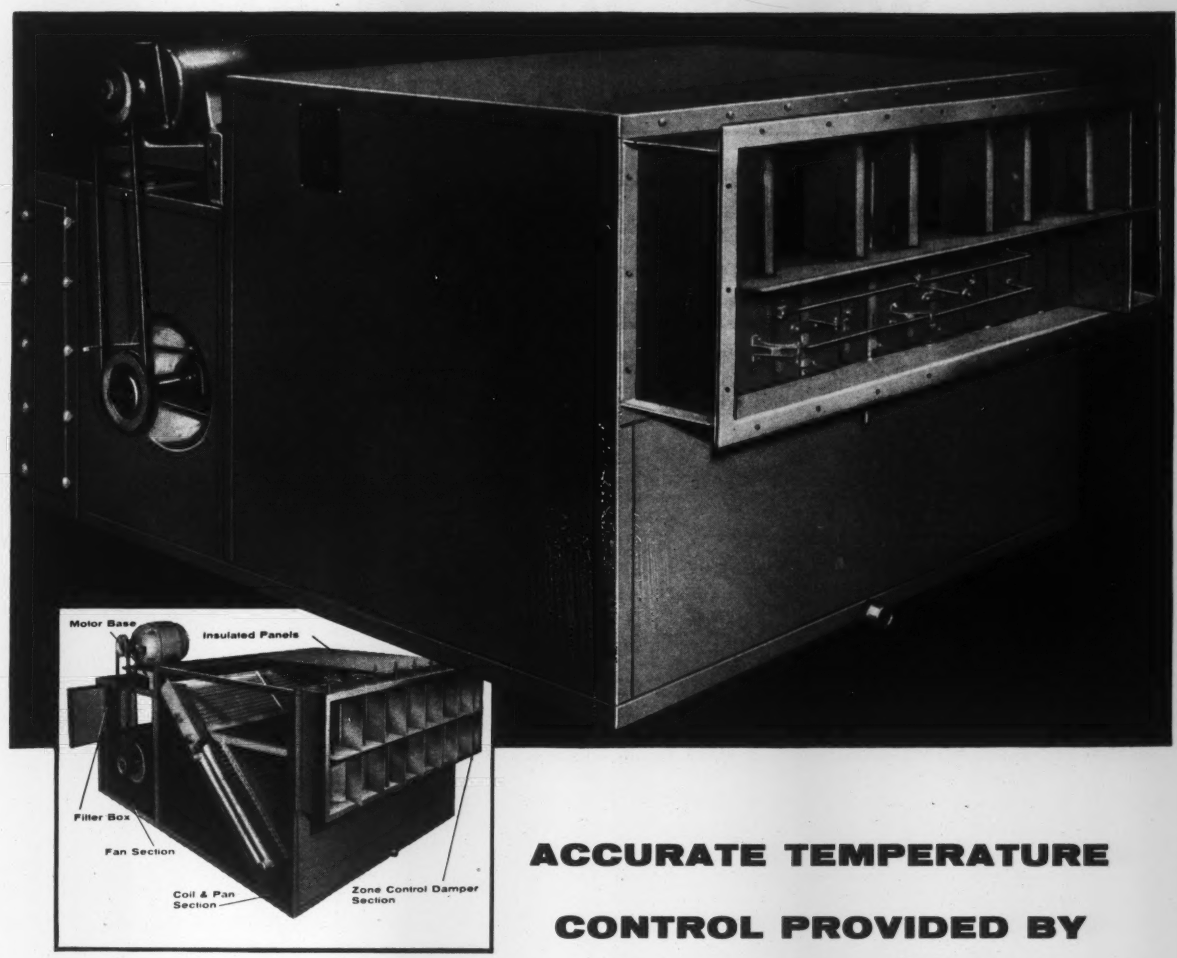

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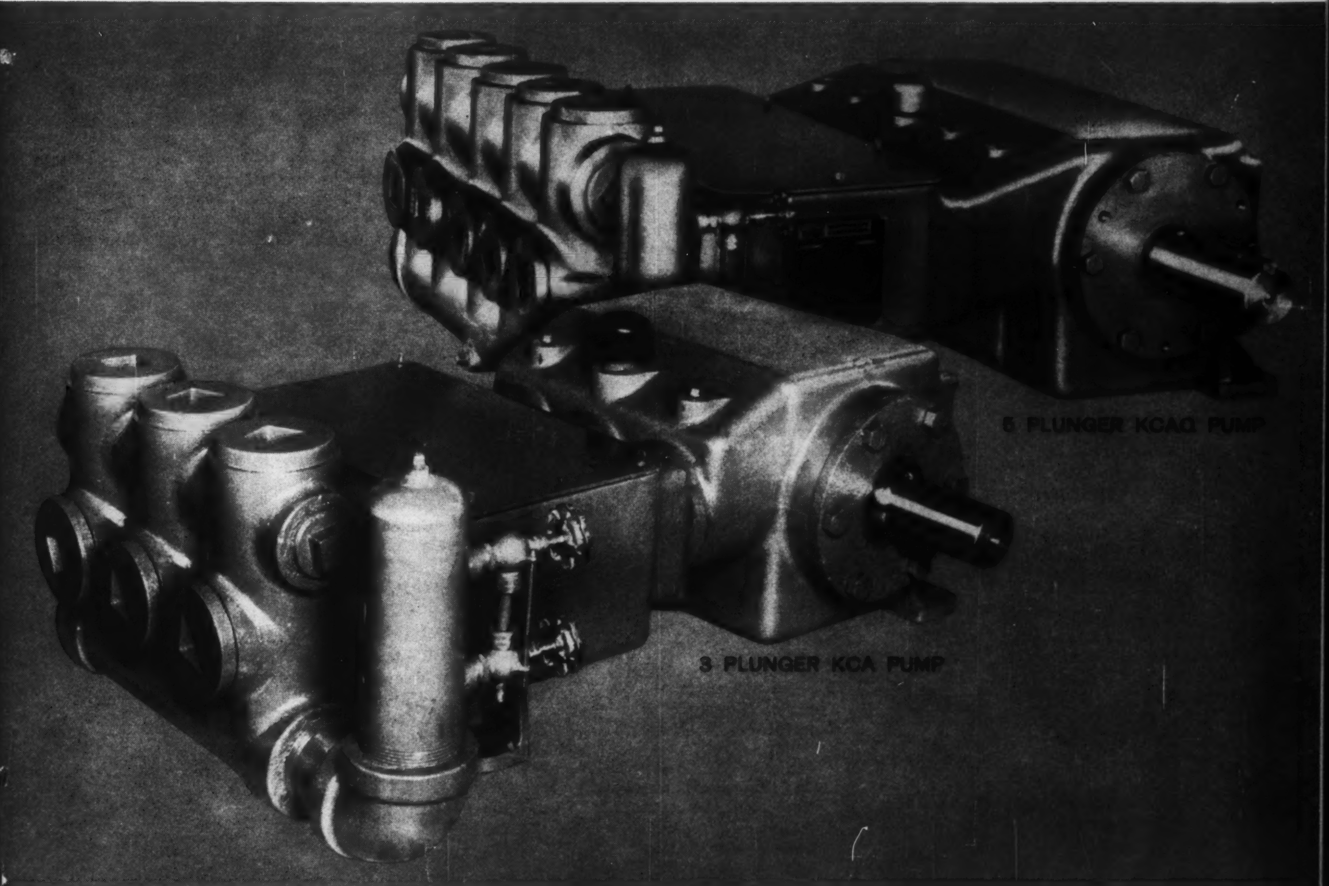

Before you buy a high pressure pump for your hydraulic application, see Worthington's new KCA and KCAQ pumps. You can depend upon these two new pumps to give you highest capacity and most pressure at truly low prices.

These horizontal power pumps save you up to 53% on initial cost. Some of the many applications for the KCA and KCAQ units include hydraulic presses and shears, steel mill roll balance, die casting, boiler feed service, descaling, cleaning and washing, fog spraying, hydrostatic testing, and rifle drilling coolants.

The KCA and KCAQ pumps have 6 outstanding features:

1. **Meets wide range of conditions.** Plunger diameters can be varied from 1¼ to 2½ inches.
2. **Fewer Spares to carry**—Wearing parts interchangeable between KCA and KCAQ pumps.
3. **Many "extras" included as standard** such as solid ceramic or Colmonoy plungers, suction air chamber to minimize noise and pulsation, plunger packing and stuffing box cover.
4. **Flooded suction adequate** because large pipe connections minimize friction. KCAQ has 4″ suction, 3″ discharge on either side. KCA has 3″ suction, 3″ discharge on either side.
5. **Less valve wear** resulting from guided, wing-type valves that are self-grinding. Liberally-sized suction and discharge valves both removable through single top covers.
6. **No shaft deflection problems.** Extra heavy crankshaft has *all* roller bearings.

For complete information, get in touch with your nearby Worthington representative. Or write to Worthington Corporation, Section 32-4, Oil City, Pa. In Canada: Worthington (Canada) Ltd., Brantford, Ont.

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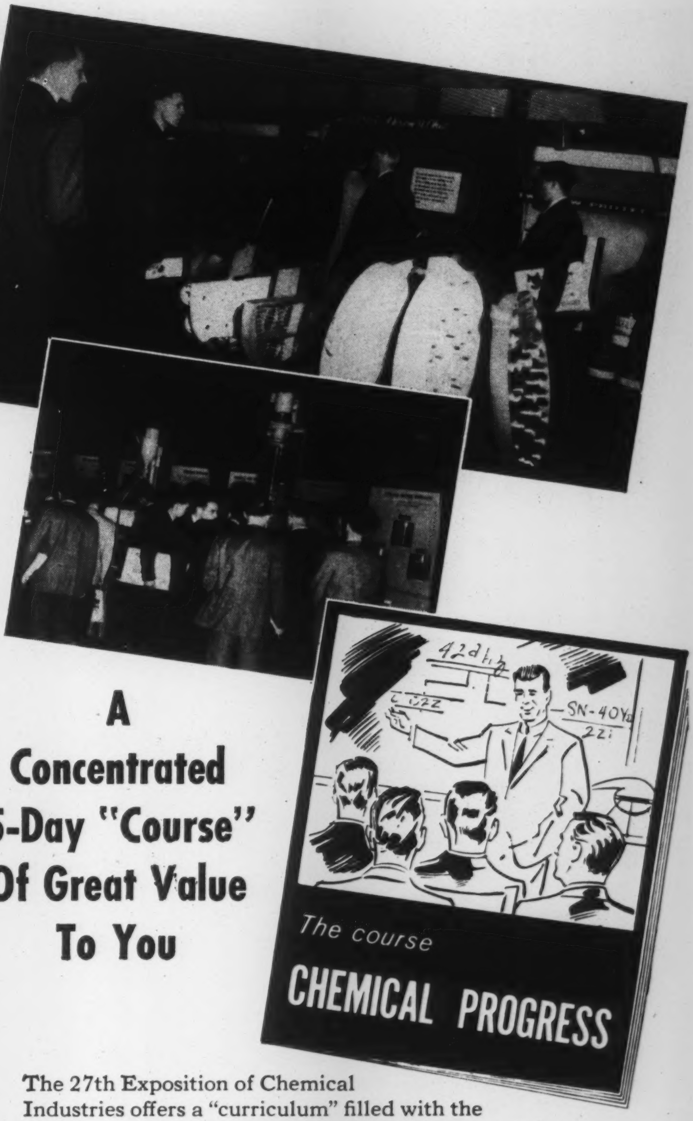

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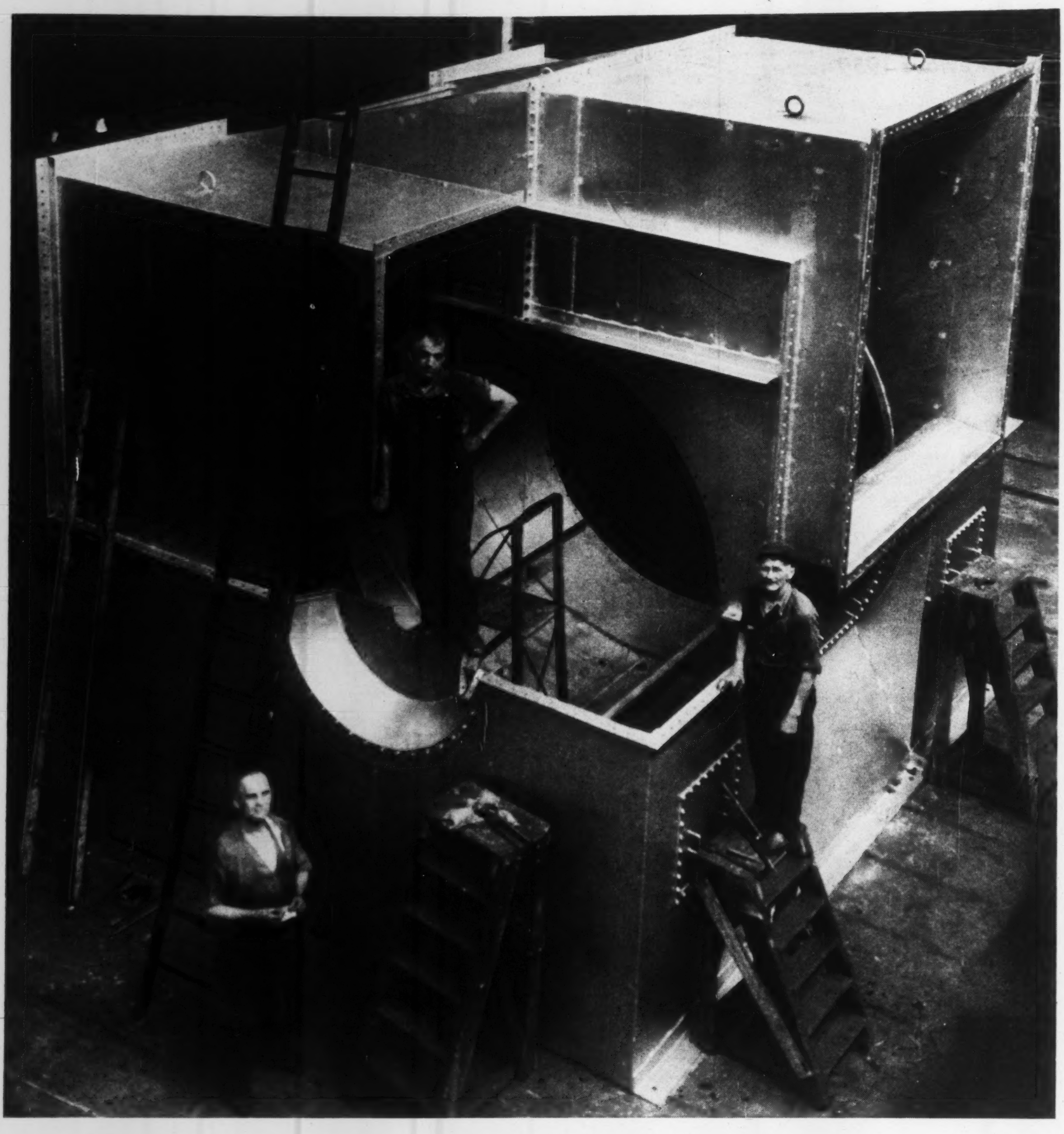

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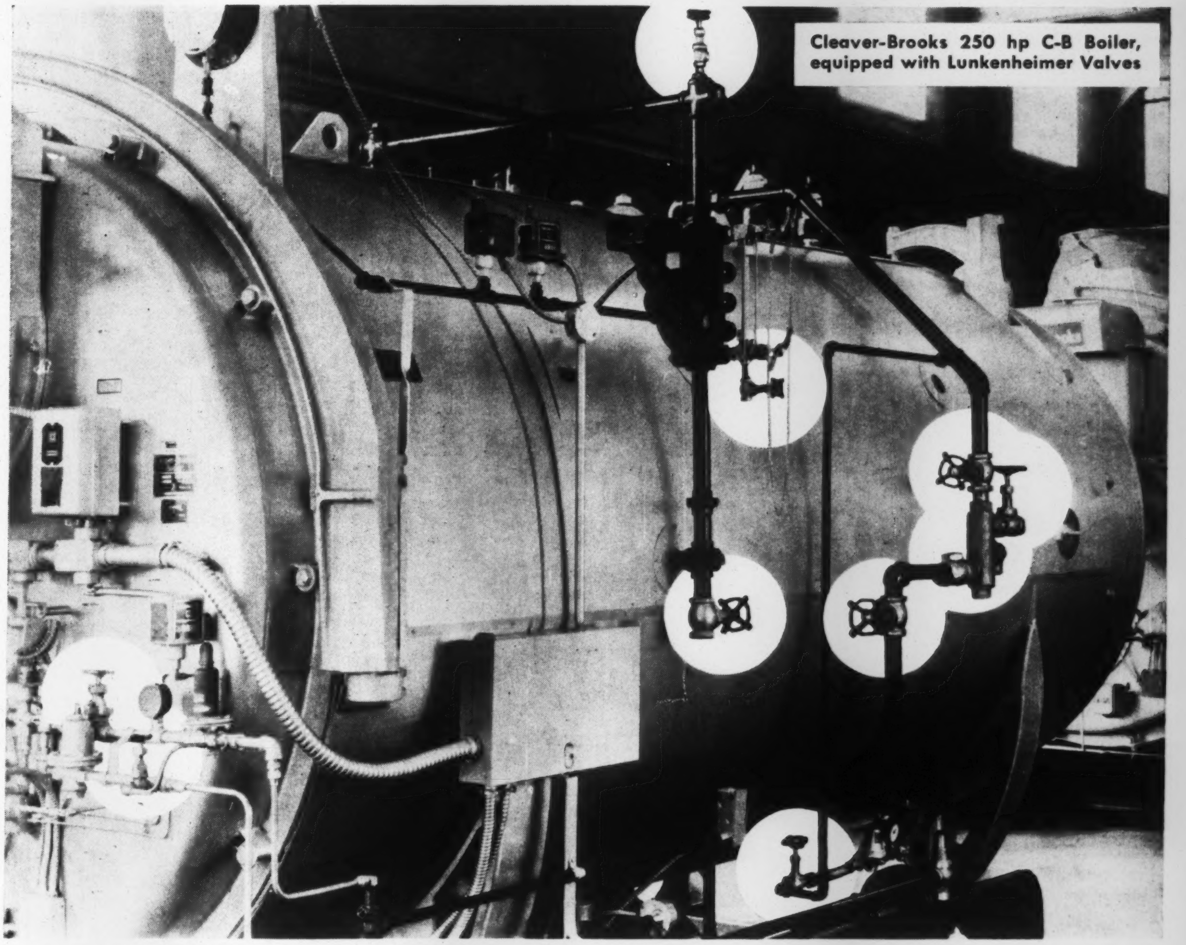

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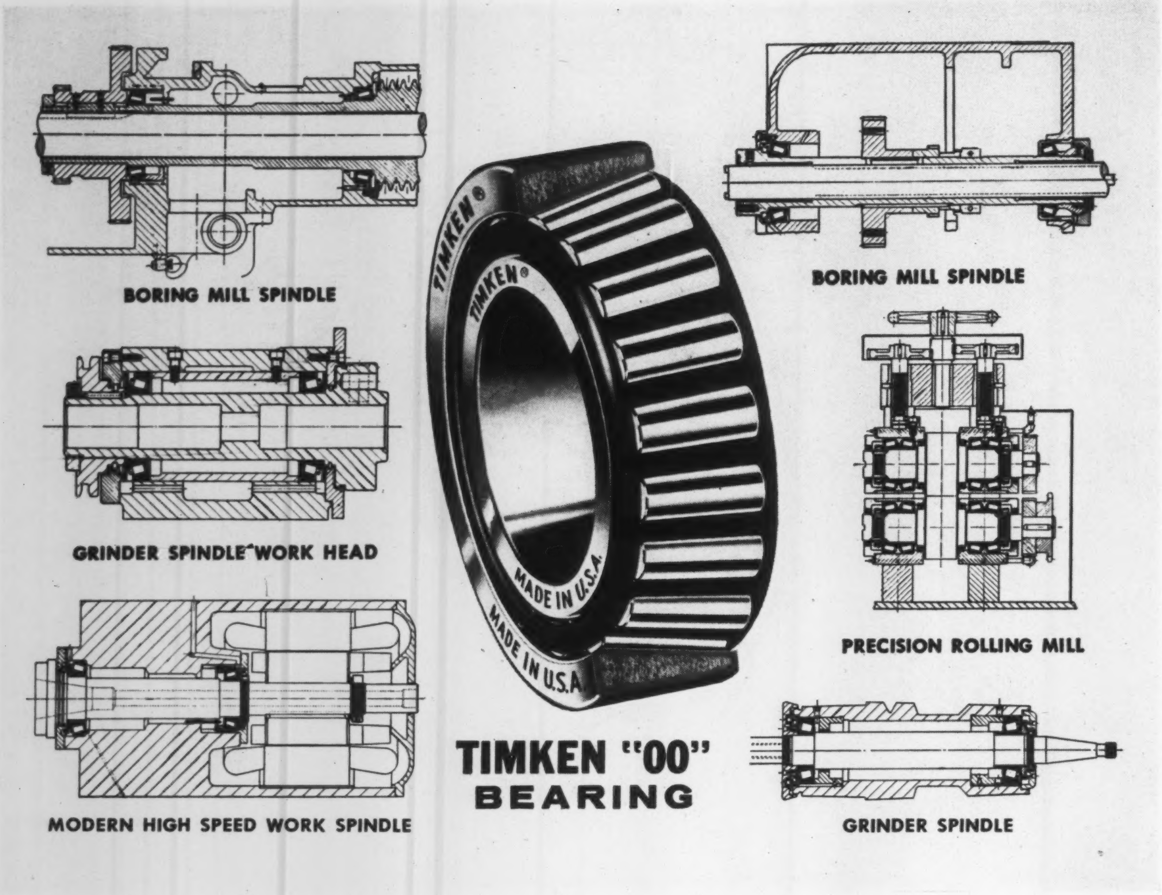

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